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THE USE AND CONSERVATION OF WATER-POWER RESOURCES.

By H. von Schon.

The conservation of natural resources has been the subject of much recent discussion. Mr. von Schon's treatment of this special phase is constructive, rather than argumentative. He does not rest content with pointing out that "something should be done," but proposes a definite, and in his opinion feasible, plan for meeting existing conditions. His article therefore has the merit of a concrete proposition, which even though it may not be accepted by some, may furnish the basis for further development. A following paper will examine carefully the economic aspects of water-power conservation, and a concluding section will illustrate the proposed policy by working out a special typical case. While the primary interest considered is that of the hydro-electric power plant, the collateral provinces of irrigaton, navigation, and flood prevention—all engineering matters of great importance—are integrally related to the subject.—THE EDITORS.

NATIONS, like individuals, may squander their substance, no matter how plentiful the store they have to draw upon, and the only hope of remedy lies in the realization of the consequences.

Water-power is one of these assets and its great importance in the future development of the country is now generally appreciated. Indeed, water *per se* as an element enters into every phase of the conservation of resources—water in its beneficent and its destructive functions; to enhance the first and to diminish the second is worth our study and aim, as the economic values of obtainable results are simply incalculable. As one of the requirements of vegetation, the carrier of burdens, the indispensable life-sustainer of man and beast, the irresistible destroyer of all that human hands may rear, and last but not least, as the source of light, heat and power—what other element surpasses its importance? Forests and food stuffs may flourish on now arid wastes by the aid of irrigation, uninhabitable swamp areas be reclaimed, the products of the fields and the mill be transported,

every community secure a bountiful and pure supply of water, homes and cities be lighted, factories and shops operated; and that the sometimes wholesale destroyer of life and property be not only rendered harmless but by the very process be made to enhance the available aggregate of its resourcefulness for all these functions—these results, and more, combine to make up the possible reward of intelligent conservation of the element, water.

In a manner we have learned to impress water for these manifold purposes, but so far only by surface methods with little thought or effort to conserve and economize, and this is especially true of its source as power.

When an individual fully awakes to the realization of wasting his substance, his first and most rational step is or should be to take an account of what remains. Water power is the expression of the dynamic energy of falling water, the energy represented by the weight of its falling volume, 80 per cent of which may be realized as mechanical, and 70 per cent as electrical power. It is in this latter form only that the future utility of water power need be considered—the form in which it may serve the purpose of men at the most convenient points, practically irrespective of distance from its prime source.

The measure of this resource is therefore the volume, flow or run-off, and its fall.

Each watercourse is a law unto itself as regards these factors, depending upon the catchment area, its character and climatic location, and the fall from its source to the efflux; and in order to take account of the available power the determination of these factors becomes necessary. The flow of streams has been the special subject of many years observation on the part of the United States Geological Survey Department, and the profiles of many rivers have been developed, but it remains to estimate what part of either is available for power development.

Theoretically, all the fall and flow of a river is available for power development, but the practicable limit is a question of economics. Successive dams may be placed so that the lower pool of one becomes the upper of the next; but this may prove in cases exceedingly wasteful in cost, as economic dam sites are not always arranged by nature with such regularity; however this ideal can be realized more frequently than may be conjectured, as it has been and is being done on American rivers for slack-water navigation; examples are the Fox river in Wisconsin, the Allegheny, Monongahela, Kanawha, Ohio, Kentucky, Green, Cumberland, Warrior in Alabama, and others.

But this is not the programme which has been pursued in the past on the rivers of New England and the northern and middle States, where dams were located because they afforded good mill sites; this was not a provident method for the utilization of all or most of the available fall. Here and there between these past developments good sites with ample fall remain unutilized, and those in the upper reaches or remote from transportation facilities still await development. At any rate, it may be considered generally practicable to develop from 70 per cent to 80 per cent of the total fall of a stream, excluding that occurring in the headwaters proper.

No such well defined limit can be quoted for the utilization of the flow. Precipitation and run-off are known well enough, but reservoir storage opportunities and extent are a closed book, except in the case of a few systems where the exploitation of navigation programmes has been extended to this feature—as for instance on the Mississippi and some of its important tributaries, the Wisconsin, Chippewa, Ohio, Allegheny and others. Lately some investigations have pursued in this direction in New York, New Jersey, Pennsylvania, Massachusetts, and Missouri, in connection with water-supply projects, but of the large number of rivers in the United States no conclusive surveys exist from which the storage opportunities and capacities could be discovered with any degree of useful accuracy.

This volume of available flow is as important a factor as the fall, as the product of fall and weight of volume represents the source of water-power energy. The past practice has generally been to ascertain the monthly run-off for a year, and to base the development upon some arbitrary condition, fluctuating, in accordance with the conservatism or haphazard judgment of the promoter or advisor, from the mean low to the mean monthly natural flow. Both extremes are wasteful either of the opportunity or of the investors' interests. Without the consideration of flood-flow storage, the determination of available flow basis should be developed from a consideration of the market demand and value of the output in order to decide how large an investment in auxiliary power plant or electric storage equipment the enterprise will stand, and the capacity of this added to the low-flow output will point to the volume which may be accepted as the available flow.

All this, however, ignores the practical storage of the flood flow, of which, as has been stated, no estimate whatever can be made because we lack the definite data. These should be plans showing the topography along the feeders, especially in the region of the head-

waters, by five-foot contours or closer. The flow in rivers fluctuates in accordance with the ground-storage capacity of the catchment areas; an area of rocky and broken surface is of low storage capacity and flow fluctuations will be of extreme character, while an area of deep drift and gently rolling surface represents large storage capacity and limited flow fluctuations. Forests, swamps, and lakes increase the ground-storage capacity to a great extent.

The Grand River in Michigan illustrates the first of the ground-storage types; its flood flow is one hundred times the normal low; the Au Sable in the same State, not more than 150 miles distant, belongs in the second class; its flood flow does not exceed double its low flow. The Grand River may rise twenty feet at some points in three days; the Au Sable does not rise more than three feet in extreme flood; this is a fair sample of steam-flow fluctuations. Little or nothing has been done in connection with past water-power developments to secure any measure of flow equalization, while the cutting down of forests has done much to lower the ground-storage capacity of catchment areas and thus to increase the flow fluctuations. What portion of this flood flow can be stored to replenish the stream during the naturally low, the growing season, cannot be known until reservoir sites are surveyed, and therefore no reliable estimate can be made of the amount of undeveloped water powers nor of the increased output of the developed powers which may be secured from flood-flow storage.

We find ourselves in the position of the man who has done business without keeping books; we cannot take an inventory of our water-power asset, not for sometime to come; and until we have these facts the practice will continue as of the past, because it is a serious and exceedingly expensive undertaking to determine the storage opportunities and capacities of a river; besides, it concerns the powers of the entire system; how therefore can the interests of one particular site be expected to go into such an investigation? As a matter of fact, they do not concern themselves much with storage problems, but make the best of a wasteful condition.

It appears from latest statistics that the present output of developed water power is 2,050,000 horse power; and from data collected by the author the undeveloped water power of New England aggregates 600,000 horse power, of New York, Pennsylvania and middle States, 1,650,000 horse power, of the southern States, 4,000,000 horse power, of northern and north-western States, 1,050,000 horse power, of the Pacific Coast watershed, 800,000 horse power, a grand total of

10,000,000 horse power. This estimate is based upon the unconserved flow, or such a volume as is available during nine months of an ordinary dry year; in other words, it is the estimate in accordance with the present-day practice of ascertaining the available power output of a stream.

A table at the end of this article gives the high and low monthly flow of some 120 rivers with drainage areas exceeding 1,000 square miles; these are compiled from the latest report of the United States Geological Survey Department. Referring to them it will be seen that the high flow of the majority of rivers exceeds ten times the low monthly flow. Is it then excessive to assume that economically practicable flood-flow conservation would double the present available water-power output? In my judgment this is a very conservative estimate. It has been said by authorities on the subject that on some of the largest American river systems, flow regulation would increase the present water-power capacities tenfold and more. However, a few examples will serve to place the above estimate in line worthy of consideration for the purpose of this discussion.

The Ohio River system is one of those which have been extensively surveyed by the United States Government in connection with the consideration of the feasibility, programme, and cost of regulating the flow, reducing the flood run-off, and thus aiding navigation and incidentally water-power developments; and resulting from these investigations it appears that the water-power capacities of the different tributaries in the present unconserved, and the feasible controlled conditions, are:

River System.	Power Capacity. With Present Unconserved Flow.		With Regulated Flow.	
Cumberland	20,000	horse power	200,000	horse power
Green	6,000	"	30,000	"
Kanawha	335,000	"	800,000	"
Kentucky	10,000	"	80,000	"
Monongahela	11,000	"	90,000	"
Ohio at Louisville	8,000	"	110,000	"
Tennessee	1,000,000	"	3,500,000	"
	1,390,000	"	4,810,000	"

According to this, the conservation of the flood waters in this system will triple the water-power capacity, and in this connection it must be understood that water-power development on these rivers under present conditions is often impracticable if the purpose is to supply continuous current service, as each flood puts the generating plant out of commission for some days, since the working head is drowned

out; and to arrange for auxiliary power sources for the entire output is generally prohibitive in cost to the enterprise. As has been stated, the increase in power output shown above is three to one. The same result may be secured on many other stream systems, and generally speaking at a much reduced cost from that estimated for the regulation of the Ohio river.

A reasonable estimate of our available water-power assets appears to be 20,000,000 horse power, representing the annual equivalent in steam fuel of about 300,000,000 tons. At $100 per horse power, this would require an investment in water-power works of approximately $2,000,000,000 and a further investment in hydraulic and electric power-generating equipment (at $50 per horse power) of $1,000,000,000. At a valuation of $35 per horse-power per annum (about 0.75 cents per kilowatt hour) for continuous service, the income at 3 per cent represents a total earning on about $20,000,000,000.

The estimated cost of the works required to control and regulate the Ohio River flow, in accordance with the programme upon which the comparative power table is based, was $125,000,000. Interest on this at 3 per cent is $3,750,000, which if distributed over the water-power output of 4,800,000 horse power is considerably less than $1.00 per horse power. But what is the value of such flood control to other interests? The damages caused by the floods during the past year in the Ohio river system have been estimated as exceeding $100,000,000; and then there are the advantages to navigation. In the case of the Ohio River flow-regulation programme the cost per horse power added to the unconserved output is approximately $30; suppose it were $50 per horse power, or an aggregate of $1,000,000,000 for the conservation of flood flow on all power streams where the existing and gained power output would warrant such a programme; then the 3 per cent on the investment needed to conserve this resource could be met by the water-power at $1.50 or $2.00 per horse power, which would be more than saved in reduced expense of cost, maintenance, depreciation and operation of the otherwise required control works, and in the enhanced efficiency of all generating equipment due to the constancy of the power factors—the flow and the head—as compared with their present excessive fluctuations throughout the year on most large water-power plants. This charge would form a premium on the most desirable and beneficent insurance which a water power could desire.

What is the value of these collateral benefits to the American people—the navigability of the rivers as a whole, the prevention of the

present annual flood destructions, the conservation and corresponding cheapening of heat fuels, and the enormous impetus given to the industrial development of the country by rendering serviceable these added power sources of the most economical form of all, hydro-electric?

Results like these here outlined can be realized only by the combined resources and powers of the whole people. The individual, the community, and State prerogatives dwindle into insignificance when considered in connection with a programme which would deal successfully with such issues. But even so, it seems feasible to outline a policy by which not only can the rights of each be fully preserved, but the benefits may be secured to the individual as well as to the people at large.

The promoters of a water-power development value the opportunity for the returns it may bring; for these they must look to the community where the power product may be most economically marketed. The interests of that community dictate that it shall facilitate the bringing to it of the hydro-electric product, provided it is offered at a cost which represents an economy from the prevailing price of power if already supplied. There is no steam or gas power plant which can compete successfully with a normally conditioned hydro-electric development; the product of the latter can always be sold for less than that of the most economically operated steam or gas plant and still leave a profit. The community's interest, therefore, is favored by granting such franchises as will enable the hydro-electric output to enter the town and compete for the light and power business, or will permit sale of the current to the existing power company.

With the way thus cleared to a promising market, the water-power people investigate the physical features of the project and very soon learn that farm land rises to city-lot prices; the farmer sees, or thinks he sees, his opportunity to sell his unproductive, perennially drowned bottom lands for more than his best upland values; and many a meritorious water-power development is shelved right there. At this point the people of the State should take knowledge, because it is to their interest as a State to have their resources developed. The development of a water power for the purpose of producing electric current for public-utility services is of as much public benefit as the establishing of a line of transportation—a railroad—and as the latter enjoys the right of eminent domain, of acquiring the necessary lands at a reasonable and just valuation, why should not the same privilege be extended to the water-power development which is projected to

render public service? In some States such is the case now. With such a privilege it seems but proper that the distribution of the current, or a reasonable part of it, should be made within the State where it is exercised; this would rarely interfere with the natural market conditions. Now the water-power project enjoys all reasonable public support until the subject of flood-water conservation is approached. There are a number of other water powers on that river; some are developed, others remain untouched; the promoters of the project in question cannot cope financially with the whole problem of flood conservation, nor is there any reason why they should, as every power owner and user on that stream would be benefited; and in many cases the owners of lands along the river and whole communities are deeply interested in preventing flood rises and consequent destruction. This is certainly a matter for the State to take in hand. The first necessary determination is the feasibility, the second the recommendable scope, the third the cost. These are clearly beyond the subject of the individual development, because of their collateral importance to the people, to the other water-power interests, and therefore logically are an affair of the State.

The State of New York has provided for just such a situation. There a State Water-Supply Commission receives in public hearing the application of the water-power company or of the community who desire the current, and they exploit the feasibility, obtainable results, and cost, and embody their findings, with plans for proposed storage works, in a report with recommendations to the State legislature.

The investigations of flood-storage opportunities should be carried on by the State. Ordinary precautions would safeguard against considerations of impracticable schemes; but even if the findings pronounced flood-water storage impracticable or prohibitive in cost, as measured by the benefits secured, this result would not be without value to the people of the State, as the facts developed will sooner or later prove useful in other directions and they certainly would for once and all establish the maximum value of that stream system as a power source.

If storage of flood waters were determined to be feasible, the State commission should have authority to designate the reservoir sites as a State water and forest reserve, acquiring title by condemnation to sufficient land to control the reservoir feeders; they should then lease the same to the lowest bidder for the construction of the necessary storage works and their maintenance and operation, fixing the amount of tolls at a certain per cent on the investment for lands and works,

which should be covered by a State bond issue. Tolls should be charged and collected from every water-power opportunity, developed and undeveloped, which will become the beneficiary of this storage, the rate being determined from the power capacity of each such power holding and assessed by the State as a tax against the properties which control a fixed minimum fall.

Where it is unconstitutional at present for the State to acquire lands for the purpose of water and forest reservations, or to construct such public works as would be required to store the flood waters, corporations could be organized and given legislative authority to perform all these functions until such time as the peoples of the States consider it desirable so to alter and order their constitutions as to give to themselves these powers and authorities, by the just exercise of which only these now wasting and constantly wasted resources can be conserved to them and their children and children's children.

The power development works should be exempted from taxation for a period of years, during which the principal of the capital investment remains a charge against them conditioned upon a specified programme of serial retirement of the securities and of their total redemption. The water-power company should be chartered by the State, the latter reserving the right of periodical inspection of its works, and of regulation of the rates charged for the product. And finally, the Federal Government upon the request of the State should examine the feasibility of creating navigation on the stream, its extent and cost; and if the findings are satisfactory, a proper navigation lock should be constructed with each power-development dam, under the supervision of the Government, and the cost thereof and of buildings and appurtenant navigation works should be defrayed by the United States Treasury, as well as the expense of any canalization or deepening of channels between such power sites. The power company should be required to acquire and lease to the Government the necessary lands for such navigation works and to furnish electric current for the operation of navigation works at an agreed-upon rate.

This, then, would secure the co-operation of individual enterprise and of the powers of the community, State, and Nation toward the object of conserving the water and all its collateral assets, of minimizing destruction from river floods, re-foresting the headwaters of streams, rendering them navigable, and developing the power resource of water to the fullest conservable extent, thereby placing within the reach of every community hydro-electric power products.

With such a policy established, water powers would assume a

definite and fixed value quite different from their present speculative status; owners of such opportunities would not continue to hold them for future enhanced valuation, as the storage tax on the undeveloped power would be the same as of the developed power, and all powers would be developed to their greatest output capacity. The State water and forest reserves would fully insure public control of these two important resources for all time to come, fuel consumption would soon be checked, heat fuel would become less costly, and the application of electric current to domestic purposes, to cooking and heating, would become feasible because of the regulation of service cost within reasonable profits to the power company.

Thus the people would come back into their own—the enjoyment of natural resources, which should be obtainable by all for the lowest practicable cost; and this generation could look with pride upon the good work of the conservation of water for those that are to come after.

A following article is to treat of the relation and the effect of successful water-power conservation upon the future industrial development of the United States as represented by the manufacturing and transportation interests, and the probable economic results, national and individual.

HIGH AND LOW FLOW FROM VARIOUS CATCHMENT BASINS,

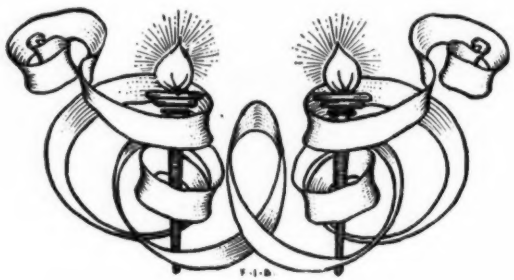
with Undeveloped Water Powers, in Cubic Second Feet per Square Mile Drainage Area.

From 1906 U. S. Geological Survey Reports.

River.	State.	Drainage Area. Square Miles.	Flow. High.	Low.
Clark Fork	Montana	6,000	0.9	0.2
Milk	"	14,000	0.3	0.001
Spokane	Washington	4,000	3.5	0.4
Methow	"	1,700	2.9	0.3
Chelan	"	1,000	5.1	1.0
Wenatchee	"	1,200	4.7	0.9
Yakima	"	5,230	2.3	0.03
Naches	"	1,100	2.9	0.06
Palouse	"	2,200	0.4	0.007
Snake	Idaho	18,000	1.1	0.2
Blackfoot	"	1,000	0.8	0.08
Boise	"	2,600	2.6	0.3
Payette	"	2,200	3.2	0.4
Owyhee	Oregon	10,000	0.7	0.002
Malheur	"	4,800	1.2	0.002
Grande Ronde	"	1,350	2.4	0.03
Umatilla	"	2,100	0.8	0.00004
John Day	"	7,800	0.8	0.03
Deschutes	"	9,200	1.2	0.06
Willamette	"	4,800	4.8	0.4
McKenzie	"	1,000	7.6	1.6

River.	State.	Drainage Area. Square Miles.	Flow. High.	Low.
Sacramento	California	9,300	4.5	0.7
Pit	"	3,000	1.5	0.008
Cache	"	1,300	2.3	0.001
Feather	"	3,600	5.9	0.5
Yuba	"	1,200	8.8	0.4
Kern	"	2,300	3.2	0.2
Kings	"	1,700	9.8	0.3
Merced	"	1,100	7.7	0.2
Tuolumne	"	1,500	9.2	0.2
Bear	Utah	6,000	0.8	0.2
Green	"	38,000	0.9	0.04
Humboldt	Nevada	14,000	0.1	0.002
Truckee	"	1,500	3.8	0.7
Walker	"	1,100	0.9	0.06
Carson	"	1,000	2.2	0.1
Yampa	Colorado	1,700	3.5	0.2
Grand	"	4,500	3.0	0.2
Gunnison	"	8,000	1.8	0.3
South Platte	"	20,000	0.07	0.001
Rio Grande	"	8,000	0.7	0.03
Sabine	Texas	3,000	1.5	0.08
Neches	"	8,000	1.2	0.1
Trinity	"	16,000	0.8	0.1
Brazos	"	44,000	0.2	0.02
Colorado	"	40,000	0.2	0.02
Guadalupe	"	5,000	0.2	0.1
Wateree	South Carolina	2,600	5.6	1.8
Broad	"	4,600	4.0	1.0
Savannah	Georgia	7,300	4.2	1.1
Oconee	"	4,100	3.7	0.9
Ohoopee	"	1,280	1.9	0.3
Chattahoochee	"	3,300	3.5	1.3
Flint	"	5,000	2.2	0.5
Pea	"	1,180	3.1	0.7
Conecuh	"	1,290	2.9	0.6
Etowah	"	1,800	3.9	0.6
Coosa	"	7,000	4.8	1.0
Oostanaula	"	1,600	4.8	1.3
Alabama	Alabama	15,000	4.6	1.2
Tallapoosa	"	2,500	5.0	1.2
Cahaba	"	1,040	5.4	0.4
Tombigbee	"	8,800	2.0	0.3
Elk	"	1,700	5.1	0.5
Black Warrior	"	1,900	7.2	0.4
Tennessee	Tennessee	21,000	2.8	1.3
Holston	"	3,000	2.4	0.9
Little Tennessee	"	2,400	4.5	1.9
Hiawassee	"	1,200	4.7	1.6
Duck	"	1,200	3.5	0.1
Shoshone	Wyoming	1,500	3.2	0.2
Little Missouri	South Dakota	1,900	0.3	0.004
Cheyenne	"	7,300	0.3	0.001
Belle Fourche	"	4,300	0.2	0.04
North Platte	Nebraska	28,000	0.3	0.04
Platte	"	56,000	0.1	0.01
Loup	"	13,000	0.4	0.1
Republican	"	23,000	0.06	0.01
Illinois	Illinois	13,000	1.7	0.5
Rock	"	6,100	1.9	0.1

River.	State.	Drainage Area. Square Miles.	Flow. High.	Low.
Cannon Ball	North Dakota	3,600	0.2	0.001
Red	"	25,000	0.7	0.05
Sheyenne	"	5,400	0.1	0.01
Pembina	"	2,900	0.8	0.04
Mouse	"	8,400	0.05	0.001
Red Lake	Minnesota	5,500	1.4	0.2
Rum	"	1,400	2.4	0.5
Minnesota	"	13,000	0.6	0.2
Chippewa	Wisconsin	6,700	3.6	0.7
Flambeau	"	2,100	3.4	0.6
Wisconsin	"	5,800	3.9	0.9
Iowa	Iowa	3,300	1.4	0.3
Cedar	"	6,300	1.7	0.3
Red Cedar	"	1,800	1.1	0.3
Des Moines	"	14,000	1.0	0.2
New	Virginia	2,700	2.9	0.9
James	"	6,200	3.3	0.7
Greenbrier	West Virginia	1,300	3.8	0.9
Shenandoah	"	3,000	2.7	0.5
Scioto	Ohio	1,000	2.2	0.2
Miami	"	2,450	2.1	0.2
Muskingum	"	5,800	2.4	0.4
Wabash	Indiana	12,000	2.4	0.3
Tippecanoe	"	1,900	1.8	0.3
Allegheny	Pennsylvania	8,600	3.2	0.3
Susquehanna	"	26,000	3.9	0.5
Juniata	"	3,500	3.7	0.7
Potomac	Maryland	9,600	2.3	0.5
Chenango	New York	1,500	4.0	0.3
Chemung	"	2,400	2.4	0.08
Mohawk	"	3,400	2.6	0.3
Aroostook	Maine	2,200	8.2	0.2
St. Croix	"	1,400	3.2	0.5
Penobscot	"	6,600	6.6	0.6
Mattawamkeag	"	1,500	6.8	0.2
Kennebeck	"	4,300	5.2	0.6
Androscoggin	"	2,200	4.9	0.9
Housatonic	Connecticut	1,000	4.6	0.9



OBTAINING ACTUAL KNOWLEDGE OF THE COST OF PRODUCTION.

By F. E. Webner.

V. THE ORGANIZATION OF A COST DEPARTMENT.

In the preceding instalments of his series, which began in our May issue, Mr. Webner has discussed the themes "What Constitutes a Knowledge of Costs"; "When and Where a Close Knowledge is Needed"; "The Profitable Use of Cost Comparisons"; and "The Use and Abuse of Mechanical Aids in Cost Finding." The series will be concluded next month with a consideration of "Cost Records as a Part of the General Accounting."—THE EDITORS.

"DEAD time," "non-productive labor," "necessary evil," etc., are expressions often used to characterize bookkeeping work, and in those plants where it is so treated the character of the results obtained from the records usually merits the titles given to the work.

Accounting is the vital element of business, and statistics show that nine out of every ten failures in business are the direct result of a lack of proper knowledge of conditions—the deficiency being due to poor book-keeping methods, or none at all. It does not always follow that a man who fails in business has not been making sales at a profit. Any shrewd manufacturer knows the danger in overbuying, or in having too many obligations maturing simultaneously, or in accepting more orders than he has capital to carry or capacity possibly to fill; these and many other analogous causes, by reason of which far too many well-meaning men have gone upon the financial rocks, bespeak the ignorance of the manager's mind concerning the balance sheet and the records supporting it until after the mischief has been done. Like the man who falls back upon the time-worn expression "didn't know it was loaded," he tells those concerned that he failed to realize how much record books really meant.

One frequently comes in contact with men who carry their business in their heads and wax fat in their business; some men have wonderful memories for dates, numbers, and amounts; but indeed, how short-sighted for such men to load a busy brain up with details which might be handled by an inexpensive clerk to better advantage, thus leaving the brain free to act on larger things. On several

occasions in my experience I have been engaged on cases involving the untangling of masses of figures resulting from certain proprietors carrying too much in their memory, and subsequently the business losing the benefits of such memory—by death or otherwise. That man is best equipped to enlarge the scope of his business who is able to duplicate himself in others; the picking of able lieutenants spells success for any enterprise. Organization efficiently builds railroads, moves mountains, spans oceans, and attains the seemingly impossible.

A highly organized selling force can move articles of inferior merit in the same territory where poorly organized forces may fail even though having the support of ample capital and a highly meritorious product. Business is a prolonged warfare, the placing of the fighting forces to do battle being arranged and possibly rearranged many times in accordance with the underlying and controlling policy. The success of army manœuvres does not rest with the fighting men alone—its engineer corps, its "flag-waggers," its commissary and hospital departments, are all important adjuncts and contribute largely to the general success; so largely that in war times we frequently heard of brilliant successes resulting almost entirely from achievements of efficient bodies of non-combatants. By the same hypothesis it must become patent to the captains of industry that the non-producers about a factory plant must be as highly organized in their respective lines as are the producers.

In years past manufacturers were, perhaps most naturally, interested first in their product and later in correcting such errors as may have crept into their original calculations and deductions; that is what first gave rise to the thought of evolving accurate costs of production. The same routine obtains even in this enlightened twentieth century when profits are calculated to a small fraction of a cent per unit. The new factory starts with a blare of trumpets and a flaunting of banners and with speeches and shouting galore; a little later on in the history of the concern the pencil and pad are brought into play to determine just where and why the mistakes were made, but these earnest searchers after truth are not always successful in gleaning the desired information; perhaps through lack of knowledge they do not discover how to make a proper start. Cost finding is an art and to one deeply interested it becomes a beautiful art. Ruskin says:

"The broader question of what these arts and labors of life have to teach us of its mystery, this is the first of their lessons; that the more beautiful the art the more it is essentially the work of people who *feel themselves wrong;*

who are striving for the fulfilment of a law and the grasp of a loveliness which they have not yet attained, which they feel even farther and farther from attaining the more they strive for it: and yet in a deeper sense, it is the work of people who know also that they are right. The very sense of inevitable error from their purpose marks the perfectness of that purpose, and the continued sense of failure arises from the continued opening of the eyes more clearly to all the sacredest laws of truth."

The old adage says "what is worth doing at all is worth doing well"; in a factory a hit-or-miss plan of guesses and logical conclusions based on a few accurate figures falls far short of the mark, and a cost system devised along such lines is indeed of low potentiality and is an expense, while a good cost system is a live asset.

The average patient, plodding machinist has not many aerial flights of thought while working at his trade; perchance he may have a retentive memory and carry in his storehouse of technical knowledge a wide range of usefulness of gears, pinions, sprockets, cranks, levers, ratchets, and all those other things mechanical which to the ordinary layman are considered only as "wheels and things." He may know and have already analyzed the construction of many unique applications of mechanical movements and be able to reproduce them, and yet have no inventive genius of his own whatever farther than perhaps to apply to a new purpose some movement he has seen elsewhere. We know him as a practical man and we have seen many of his kind develop into foremen and into *good* foremen——foremen who are worthy of and receive the respect and admiration of both their employers and employees.

Inventors of machinery are very largely dreamers and theorists—persons lacking a wide technical knowledge of modern machine-shop practice. It is not at all uncommon to inventors to think and even define an eccentric cam as a wheel with its center at one side; such men, however, usually have enough genius in their make-up to make themselves clearly understood by the machinist who is to undertake to carry out the plans of the inventor, after applying thereto his own technical knowledge of the movements embodied in the plan.

The difference between the theorist and the practical man is analogous to that difference which obtains as between the inventor and the machinist—one plans work for the other to do—one sets the mark for the other to strive for, and evolves plans with an eye single to the usefulness and beauty of the structure. The theorist and the inventor have dreams which they want realized; the function of the practical man is to carry out the plans of the dreamer with, perhaps, a change of detail here or there. Each needs the

other, for it is an almost infallible rule that the so-called practical man is prone to measure efficiency by immediate results and fails to discern the greater and broader results which the theorist has in mind.

A cost department should be like a well built machine; and it can be, with the right kind of men—men who will devote their earnest energies to the cause and not "back and fill" in the harness, but will keep a firm determination to reach a successful climax. It sometimes happens that the practical man, not having his heart in the cause, will show his reluctance to acknowledge any possible short-sightedness by failing to apply records to their fullest use; this however is only a prolonging of the inevitable season of anxiety attendant upon the installation of a new cost system, or any other new system. If the originator of the plan has been commissioned to "carry a message to Garcia" and is given sufficient latitude to produce those results for which he is to be held accountable, all the petty annoyances and causes of friction will worry themselves out in due course of time. Ultimate success depends upon the decisions of the management in determining between the best interests of the business and the pig-headedness of certain of the men.

Theorists are safe enough when they take cognizance of known facts and cardinal principles and, by all means, the cost system should be planned by a theorist—a safe one—and carried on by a careful clerk—an optimist. Incidentally, an optimist has been defined as one who sometimes hears of people doing just as he would have done had he been there; the cost clerk must feel as though he would have done it the same way had he been asked how at the start; he will then unwittingly feel a certain proprietary interest in the general and detail plans; he *must* be in sympathy with them, else he cannot—or perhaps a more proper expression is that he ***will not*** —adhere strictly to the spirit as well as the letter of the rules governing his clerical operations.

To make the proposed cost system successful one man must be in supreme authority in the cost department; there may be as many sub-heads and subordinates as appear necessary, but one man must have the authority to adjust petty differences in his own realm, and to a limited extent he must have authority to enforce the cost-system rules made for the guidance of employees in the producing departments, through proper channels—that is to say, always through the foreman concerned and never with any attempt to pass over the foreman's head. The clerk or clerks who are to

come in contact with the various foremen and the shop men should be possessed of a jovial disposition, so as to enable them to work smoothly and without friction in the discharge of their clerical duties; a crabbed clerk can do much to rub the shop men the wrong way and keep a spirit of discontent in constant ferment; this is a matter to be watched very closely in the assignment of duties in the cost department. In large plants where a number of clerks are to be required in the cost department, the subordinates can be picked just as they are for any ordinary clerkship, namely, by their personality, honesty, handwriting, and ability to handle figures correctly; their promotion should depend largely on ability to do effective work in the factory without incurring the displeasure of the workmen.

The chief end of business enterprise is net profit; many workmen overlook that fact; they will occasionally make spurts to get out a large volume of product in a given month, but are utterly unconcerned as to the burden of overhead expense. The average employee loses much of his possible value on this point and resents suggestions of economy. I have in mind an air-brake instruction car in existence some years ago; it was for teaching engineers the proper use of compressed air in stopping trains—the idea that any resentment should be felt did not occur to the management of the railroad, but the engineers did not take kindly to the measure and some were quite exercised over the matter. One of the great wastes in a factory is traceable to this weakness in human nature, and education on this point is well worth the judicious expenditure of money and effort.

The man in charge, upon whom devolves the carrying out of the ideas laid down by the originator or architect of a cost system, must be to such a cost system just what the practical machinist hereinbefore mentioned is to the inventor. The man in charge must be one who can and will do things as far as possible along the lines laid down for him, and not be ever ready with a hundred and one excuses and reasons why certain things cannot be accomplished. If obstacles arise that he cannot get around he must get over them—get on the other side some way or other, and get there without too great a cost. New systems of any kind have all up-hill work, and far too many of those concerned are quite too apt to place obstructions rather than clear the way for easy running. The moral support of every one concerned should be insisted on as far as possible, and subordinate clerks in the cost department should be instructed either to speak well of the innovation or, aside from their regular duties, not

speak of it at all either inside or outside of the works. A thing is often damned by faint praise; and while superficially it might appear that the workmen in the factory have nothing to do but to follow instructions, they can, at times, follow with such an apparent density in comprehension as to make the general plan burdensome and costly. Hence, if the workmen can in a measure, be cajoled into making their reports promptly and correctly and accepting suggestions of economy without growling, it helps the good cause vastly more than to have them come in contact with cost clerks who themselves are inclined to be pessimistic about the good which is to result from their efforts, and therefore more or less lackadaisical about the performance of their duties.

The man who is put in charge must not have his hands tied so that he cannot accomplish results, and moreover he must be given moral support by the powers that be, and an *esprit du corps* should be encouraged.

Too much must not be expected from the newly organized force at the start; and if at the end of a year the results are showing fairly well, it can be considered a successful installation.

STORAGE BATTERIES. THEIR CONSTRUCTION AND USES.

By Percival Robert Moses.

In this article Mr. Moses discusses in very clear and practical fashion the utility of the storage battery as a means of energy storage in isolated electrical plants, the conditions to which it is best adapted, and the economies which may be effected by its use. The present instalment illustrates strikingly the function of the storage battery in a private plant by a review of the conditions under which such plants in New York City are supplied with auxiliary and breakdown service by the large electrical companies, and describes the construction and operation of the leading types of batteries on the market. A concluding section, to follow next month, will treat of the battery as an actual part of the generating equipment, the methods of charging and discharging, the types of boosters and other auxiliary apparatus adapted to various conditions, and the cost of installation and maintenance.--THE EDITORS.

TO the average purchaser not trained in electrical matters, the storage battery is a somewhat mysterious, expensive piece of apparatus subject to costly maintenance charges; and as the battery is not as essential an element of a power plant as a boiler or an engine, the result of this general impression has been to prevent the installation of batteries where the economical operation of the system as a whole really indicated their installation.

The value of the storage battery in isolated-plant work has recently increased materially in New York City and vicinity, because of the ruling of the Public Service Commission to the effect that while the central-station company was bound to furnish breakdown or auxiliary service to owners of private plants, the central-station company was entitled to receive a guaranteed minimum annual receipt sufficient to pay fixed charges on the installation necessary to care for the customer's service. After much discussion, a rate of $30 per annum per kilowatt of maximum demand was agreed upon as a fair charge. It was also agreed that the customer could fix his maximum demand, and suitable circuit-opening arrangements would be installed to prevent the taking of more than the agreed allowance. It may be well to state, to avoid possible misunderstanding, that the customer is entitled to use current up to the $30 agreed minimum return per kilowatt maximum demand without additional charge, and this current may be used at any time during the year, additional current to be charged at regular rates.

The use of a means for storing electrical energy under such a contract is obvious where apparatus is to be supplied which requires rapidly varying quantities of electricity, such as electric elevators or direct-connected press motors. Without a battery the maximum demand would equal the high point of the load curve with a fair margin for contingencies and overloads. With the battery, the maximum

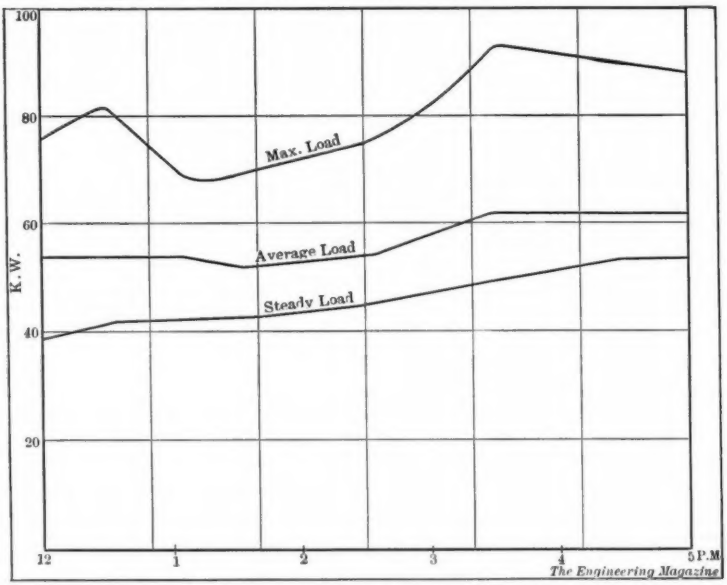


FIG. 1. TYPICAL LOAD CURVES SHOWING DIFFERENCE BETWEEN MAXIMUM AND AVERAGE DEMAND.

demand may be fixed at the average requirement for a period of hours. Curves given in Figures 1, 2, and 3 show the average load and maximum demand in the case of some elevator and other installations. The ratio may be as much as 1 to 10 in the case of two high-speed elevators and a small lighting load. In such a case with a battery the maximum demand could be fixed at 6 kilowatts, costing $180 per year; while, without the battery, it might have to be fixed, to take care of all possibilities, at 60 kilowatts costing $1,800 per year. The greater the number of elevators or of other motors, the greater proportion the average load will be of the maximum demand, and the less valuable will the battery be for the purpose mentioned.

An analysis of the basis of the charge of $30 per kilowatt maximum demand, is illuminating. A maximum demand of 1 kilowatt

by a stated installation, requires an investment in power house and equipment, in mains, feeders and ducts in street, in metering appliances, and in franchise and patent rights, and in taxes; all of which are additional to the actual cost of manufacturing the current. This investment, allowing for the installation at the station of one-third of a kilowatt for every kilowatt connected in the consumers' premises, amounted to about $200, on which 10 per cent may be allowed for fixed charges, or $20 per kilowatt, leaving $10 for manufacturing $30 worth of electricity, equivalent at current rates to about 400 kilowatt hours, or 2½ cents per kilowatt hour; that is to say, of a total cost for current, two-thirds was chargeable to investment and one-third to manufacturing cost, and this, notwithstanding the fact that the central station, because of its many customers operating under varying conditions, only needs to install less than one-third of the capacity which would be required if all the installations used their maximum requirements at one time.

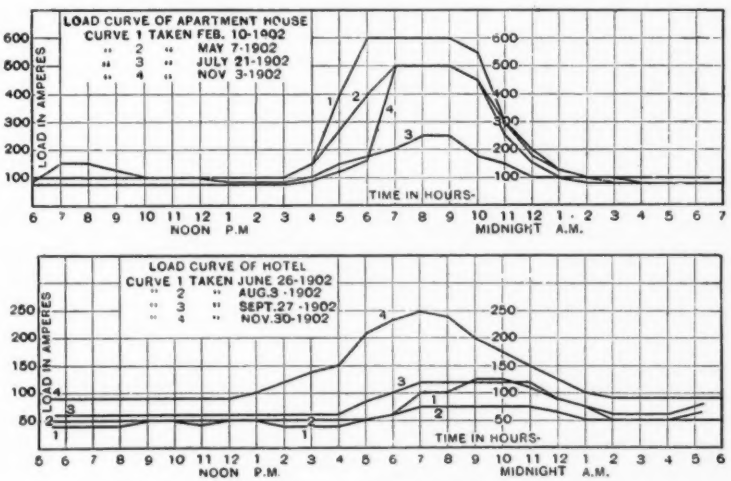


FIG. 2. TYPICAL LOAD CURVES OF A HOTEL AND OF AN APARTMENT HOUSE.

The use of a storage battery in an isolated plant in connection with a central-station auxiliary service, and a charge on basis of maximum demand, has been described, notwithstanding its limited application, because it points out clearly and definitely the main function of a battery in all isolated-plant installations. Such a plant does not have any expenditure for street mains, feeders, franchises, taxes,

etc., but the plant installation must be at least equal to the maximum demand, and usually because of need of a spare unit, from ¼ to ½ more than the maximum. Therefore, for a maximum demand of one kilowatt, the plant installation will be from one to one-and-one-half kilowatts, costing from $100 to $150, on which the fixed charges will be from $10 to $15 per annum. This should be compared with the $20 allowed the central-service company for maintaining its service in readiness.

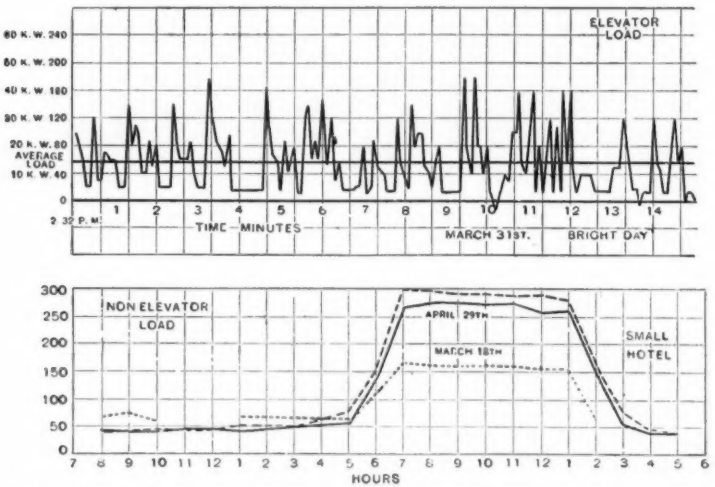


FIG. 3. LOAD CURVE OF A BUILDING WITHOUT ELEVATOR, AND A TYPICAL ELEVATOR LOAD CURVE.

From the foregoing, it follows that for every kilowatt of maximum demand in a private plant, the owner of such a plant has to charge the operation with from $10 to $15, or an average of about $12.50, per year for fixed charges alone, and if he can reduce the maximum demand by some system of energy storage to something approximating the average demand, he can reduce the total operating cost by the difference between the fixed charges on a plant big enough for the maximum demand, and one big enough for the average demand including the storage system.

In the case cited, of the elevator system of two elevators with a maximum demand of 60 kilowatts and an average of 6 kilowatts, the fixed charges in one case would be about $750 per year, and in the other $75; and the purchaser could afford to pay $6,750 (the differ-

ence in fixed charges capitalized at 10 per cent) for an energy-storage system, leaving out of consideration any question of operating expenses. This case, of course, is one especially favorable to a storage system, but it represents the conditions existing in a number of actual installations.

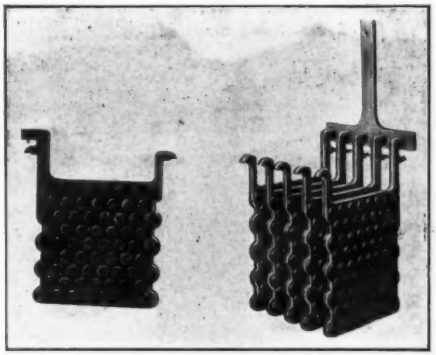


FIG. 4. POSITIVE PLATES, ELECTRIC STORAGE BATTERY CO.

In so far as operating expense is concerned, on one hand there is the cost of maintaining and renewing the energy-storage system; and on the other hand, the savings due to decrease in use of fuel, oil, machinery repairs, and labor. It is hard to fix definitely the saving in fuel, oil, and repairs, due to a storage system; each plant has different conditions, and the question of the amount of low-pressure steam required for heating and hot water has an important bearing on the fuel question. It is evident that, omitting the question of steam for heating, etc., it is much cheaper to run a 100 horse-power boiler and 60-kilowatt unit under a steady load of nearly full capacity than to run a 160 horse-power boiler with a 100-kilowatt unit with a rapidly varying load of from 50 to 100 kilowatts, and it is equally evident that the strain on the engines and dynamos must be far greater in the second case than in the first. In several instances in my practice, only one unit is running now during the great part of the operating period where two operated before the storage system was installed.

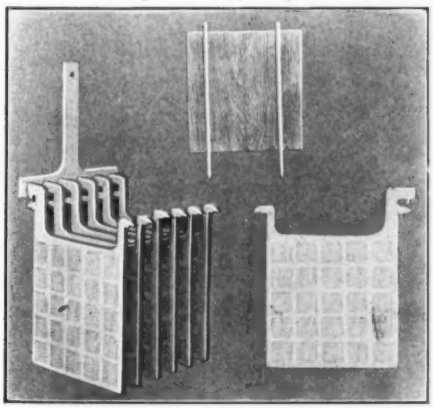


FIG. 5. NEGATIVE PLATES, ELECTRIC STORAGE BATTERY CO.

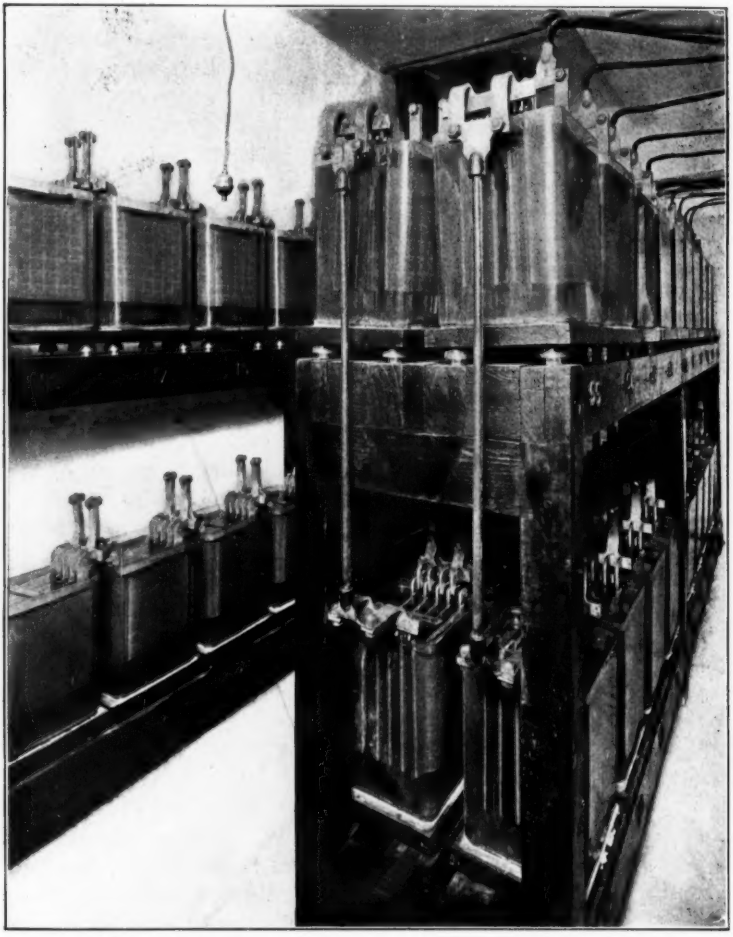


FIG. 6. BATTERY ROOM, VANDYCK AND SEVERN APARTMENT HOUSES.
Electric Storage Battery Co.

As to the labor, where a plant is operated 24 hours a day for other purposes than generating electricity, there will probably be no saving in labor, except in maintenance of engines, but where a plant need operate only part of the 24 hours, and can then be shut down, leaving the storage system to supply the energy the rest of the period, the reduction in labor may become the most important saving obtained by the installation of the storage system.

So far in this discussion the term "Storage System" has been used because the results mentioned, with the exception of the labor-saving item, would apply to any system of storing energy.

There have been other systems proposed, such as storage of hot water under pressure to supplement the boilers at peak-load periods. This system is not practical, and would not equalize the load on the engine and dynamo, nor would it take care of the short period in fluctuation of motor loads.

Another system, which is now being used in rolling-mill work, consists of a motor-generator connected to and revolving an enormously heavy flywheel, the flywheel supplying the energy necessary to care for the sudden fluctuations of elevator and rolling-mill work. This system might be arranged to take care of such momentary fluctuations, but it would be of no value in connection with the heavy short-period increase due to sudden lighting loads on dark days, nor as a reserve. Its main value is to avoid overload of the motor and

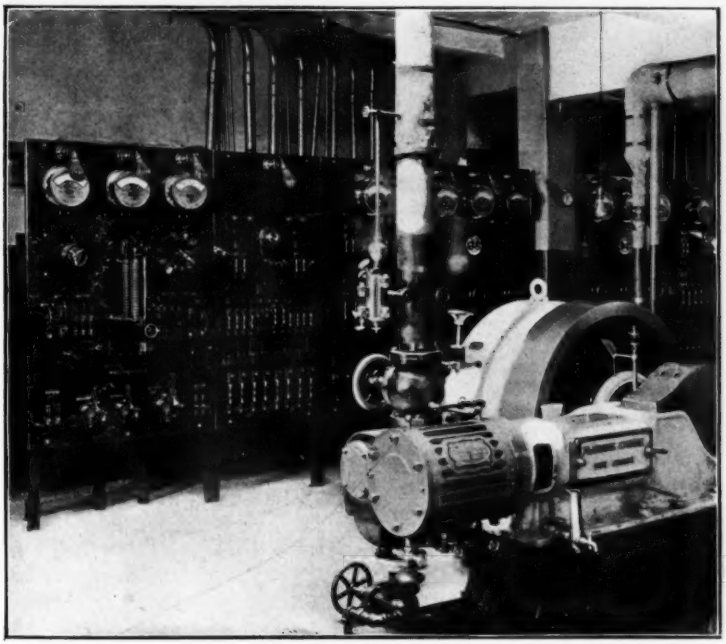


FIG. 7. SWITCHBOARD AND ENGINE ROOM, VANDYCK AND SEVERN APARTMENT HOUSES, NEW YORK.

Showing regulator and end-cell switch on switchboard.

prevent stoppage of the mechanical operation because of such overload. The reserve capacity for breakdowns and light-load periods is of great importance, even if it is only sufficient to supply a small portion of the total equipment for a few hours; as for example, a fire pump, an elevator motor, a printing-press motor, or a hundred or so lights at night after regular operating time. It is mainly for this reserve capacity in emergency that the large central-station companies maintain their large battery plants, and they have proved a "friend in need" on several occasions when feed or steam pipes burst.

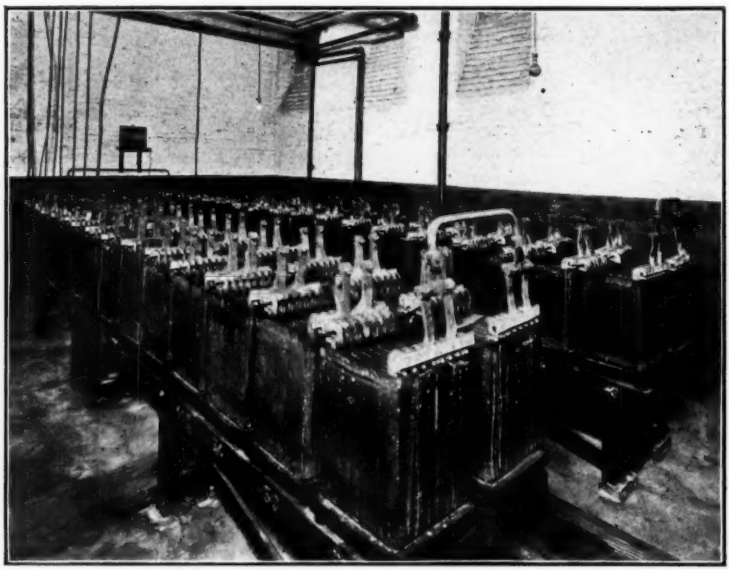


FIG. 8. BATTERY ROOM, CHATSWORTH APARTMENT HOUSE, NEW YORK.
Electric Storage Battery Co.

Another feature of an energy-storage system is avoidance of the fluctuations in voltage, and hence in lights, as heavy loads go on and off the system. Such variations are partly absorbed in plants without batteries by heavy flywheels and mechanical governors, and may be stopped entirely by electrical governors operating on the dynamo field. It is, therefore, not necessary to install a battery to take care of these fluctuations, but if a battery is otherwise advisable, the governing problem is simple, as the load change never reaches the engine and dynamo.

The function of a battery is exactly that of a gas tank in the

manufacture of gas, or a reservoir in the supply of water. It is a reservoir of electrical energy, and it is the purpose of this paper to describe simply the various forms of batteries in use, some of the methods adopted for automatically charging (*i. e.*, filling up) and discharging (*i. e.*, emptying) the battery.

Storage batteries in connection with electric plants always consist of lead plates submerged in dilute sulphuric acid contained in glass jars or lead-lined wooden tanks. Each jar contains a number of these lead plates divided into two sets known as positive plates and negative plates; all the plates of one set are connected together by burning to a strip of lead, and this strip of lead is connected to the strip of the next jar. The positive strip of one jar is connected to the negative strip of the next in order, to add the voltage of one jar to the voltage of the next. In this way, by the installation of a number of cells in series, any desired voltage may be built up, each cell giving about 2 volts on discharge, so that for 120 volts, a battery of 60 cells is required.

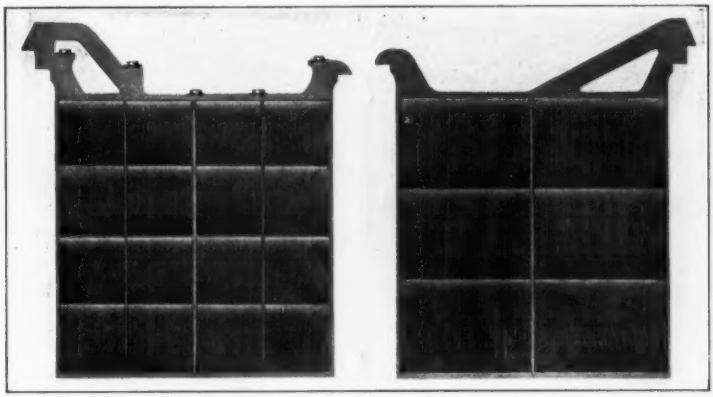


FIG. 9. POSITIVE AND NEGATIVE TYPE "S" PLATES, GOULD STORAGE BATTERY CO.

The method of storing electrical energy is simple, and depends upon the fact that the passage of electricity from one plate of lead oxide to another plate of lead oxide, when these plates are immersed in dilute sulphuric acid, changes the lead oxide of one plate to sponge lead, and the lead oxide of the other plate to peroxide of lead. This is the process through which the battery goes on charge. When it is desired to obtain electricity from the battery, it is only necessary to connect the terminals to some channel which will allow electricity to flow, such as a lighting system, or a motor, and the lead peroxide

plate will begin to lose its oxygen and the sponge lead to take on oxygen again, and the result of this chemical action is to generate an electric pressure of about 2 volts which causes electricity to flow.

This is briefly the story of battery operation; charging is the rusting of the positive plate and the de-rusting of the negative, and discharging is the partial de-rusting, or reduction, of the positive plate, and the rusting or oxidation of the negative.

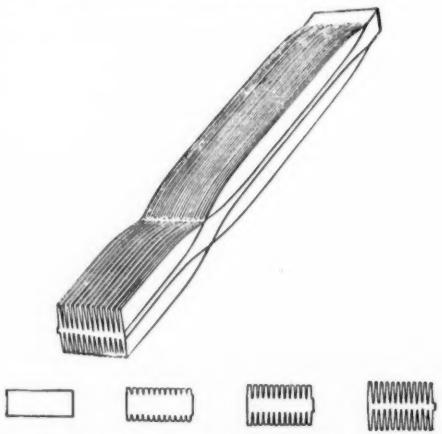


FIG. 10. SHOWING METHOD OF SCORING PLATES FROM LEAD SHEETS BY "SPINNING" ROLLS.
Gould Storage Battery Co.

If the chemical reaction stopped at this, and if lead were a substantial material and not given to expansion on rusting, the storage-battery problem would not have required the expenditure of money and brains, but, unfortunately, the chemical reaction does not stop but continues, and the lead oxide takes on sulphate and becomes lead sulphate, and this lead sulphate has the objectionable property of being an insulator and almost impervious to the passage of electricity; the lead oxide, instead of being strong and stable, is brittle and expansive on peroxidization, and these two facts are the cause of almost all the battery difficulties. The sulphating of the lead plates is not a serious trouble, with correctly designed plates, if the discharge is not carried too far. If the discharge is kept within well defined limits, as evidenced by the specific gravity of the solution and the voltage of the cells, the sulphating does not proceed sufficiently far over the active surface of the plates to prevent the passage of sufficient current on charge to regenerate the battery and drive the sulphate back into solution. It is the removal of the sulphate from the acid on discharge that reduces the specific gravity of the solution, and it is for this reason that the specific gravity is used as an index to the battery's condition. The expansion of the lead peroxide, or lead sulphate, and its brittle quality are two of the principal causes of the variety of forms of plates. All these plates have for

objective the offering of the greatest amount of lead oxide or active material to the action of the acid solution consistent with maintaining a close contact (to reduce resistance) between the active material and the supporting surface or plate and, at the same time, giving room for expansion of the active material as it changes to lead sulphate or peroxide.

In one form of plate, the Manchester, made by the Electric Storage Battery Co. of Philadelphia, these results are obtained by forming the original lead oxide in a strip with corrugations on one side (see Figure 4). This strip is wound into a button and pressed into circular openings in the plate. The expansion of this button is then resisted radially, and incidentally the expansion tends to make the contact between active material and plate more perfect. Figure 5 shows the negative plate of this company known as box negative because active material is held in what is really a perforated lead box.

FIG. 11. BATTERY INSTALLATION, GOULD STORAGE BATTERY CO.

Another company, the Gould Co., forms its active material on leaves scored from the lead sheet (see Figure 10). These leaves are vertical and thicker at the base than at the ends, the space between being allowed for expansion of material.

A third form of plate, the Bijur plate made by the General Storage Battery Co., uses a grid with horizontal heavy bars and vertical cross

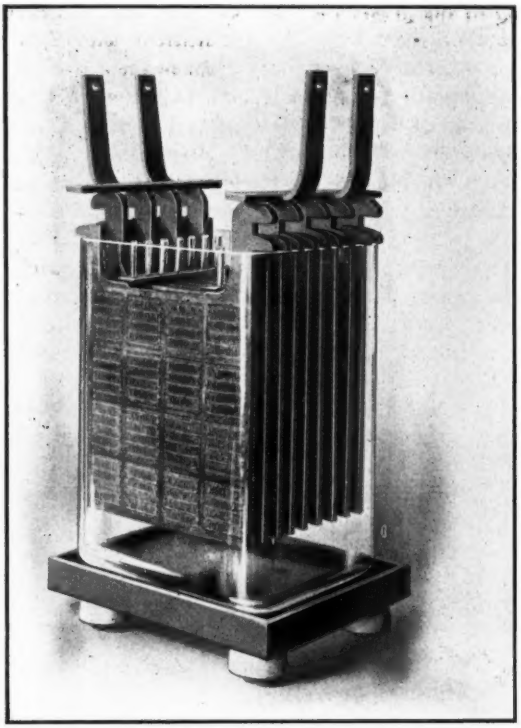


FIG. 12. CELL AND PLATES, GENERAL STORAGE BATTERY CO.

bars (see Figure 12), the oxide forming on these bars, and the expansion being taken care of by space left between the body of the plate and the grids.

In both the Electric Storage Battery and the General Storage Battery plate, the frame work is of lead mixed with antimony, this being stronger than pure lead and less easily attacked by acid. The Gould plate is all lead without alloy.

It may be well to state that although sponge lead and pure lead are apparently the same chemically, they do not act in the same way, as the pure lead is hardly affected by the passage of electric current from one plate to another, while the sponge lead is at once oxidized. It is this fact that makes it necessary in the first manufacture of the active material on the plates to do the preliminary oxidization of the plates by some acid such as nitric acid, and it is of the greatest importance that this acid be entirely removed before the plates are put into service, or the process of forming, *i. e.*, oxidation, will go on until the plates are destroyed.

The life of the plates, which are the only perishable parts of the battery (except for minor matters, such as separators and acid), depends almost wholly on the number of charges and discharges, *i. e.*, the amount of oxidization which has taken place. The oxidization, like

the rusting of iron, is progressive; first the outer layer, then deeper and deeper until the whole of the available material, whether corrugated ribbon, grid, or leaf, is oxidized. As regards this progressive rusting, there are two theories; the one advocates arrangement to allow dropping off of the particles as new oxide forms, the other advocates the holding of as much oxide as possible with the idea that the capacity depends on the quantity of material, and the more oxide the more capacity. The latter theory seems the better grounded, as it is well known that the capacity of the negative plates decreases because of the gradual falling off of the active material, and as the oxidization is not progressive on these plates, due to the continued de-rusting on discharge, the capacity of the negative plates decreases.

The falling off of the active material results in a deposit in the bottom of the jar or tanks, which must be cleaned out before it reaches the plates and forms a short circuit. For this reason the jars should be from 2 to 3 inches longer than the plates. The oxide also forms trees and growths on side of plates, and these must be prevented from growing to the next plate. One method is that of using glass separators, the other that of using porous wooden separators. The latter plan has the added advantage of making the discharge

FIG. 13. BATTERY ROOM, ROLLING MILL PLANT, CAMBRIA STEEL CO.
Floating battery. Bijur "high-duty" type. Regulating capacity, 600 k. w. General Storage Battery Co.

from one plate to the next more uniform than it would be without the diffusing separator.

It is not possible to touch on the various minor matters entering into manufacture of batteries—this is properly the province of the writer of a book on the manufacture, but the essential simplicity of the battery has been shown, and the matters noted in which care should be exercised, are well known and recognized by successful battery manufacturers.

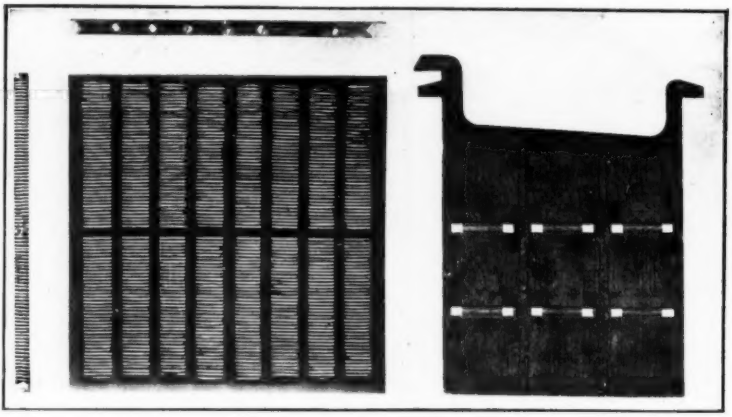


FIG. 14. WESTINGHOUSE STORAGE BATTERY PLATE, BEFORE AND AFTER CHARGING.

In the operation of batteries, the only thing necessary is intelligent inspection; the battery companies provide blanks showing advisable specific gravity readings and voltmeter readings, and if these be taken regularly, and the results be watched intelligently, no trouble need be feared, provided the manufacture has been carried out under careful inspection and supervision, and the battery is designed large enough for the work. There is one important point which should not be overlooked; viz., no foreign gas or substance must be allowed to enter into the solution. The batteries when fully charged give off sulphuric acid vapor which is extremely corrosive; hence any iron in the room is liable to corrosion, and the presence of iron in the acid would be fatal to the cell in which it appeared. Salt or ammonia would be equally objectionable, hence brine or ammonia pipes should be kept out of battery rooms; and any pipes necessarily in the rooms should be heavily protected with non-corrosive paint. Excessive temperature, *i. e.*, over 100 degrees Fahrenheit, is also objectionable, as tendency to internal chemical action increases.

MODERN DEVELOPMENTS IN THE METALLURGY OF LEAD AND ZINC.

By A. Selwyn-Brown.

One of the most salient features of modern practice is the successful handling of low-grade materials from which the value could not be profitably extracted by older methods. While the following review deals primarily with base metals, the author leads up to the important conclusion that as these almost always carry recoverable amounts of gold and silver, we have here a further important activity at work multiplying the world's store of the precious metals and hastening the economic effects which such an increase must produce.—THE EDITORS.

IN order to meet the demands of the world's markets for lead and zinc, in recent years, mine owners have been compelled to develop low-grade deposits. This, in its turn, has demanded improved methods in mining and metallurgy. The demands have been well met, and as a result we have witnessed, in a comparatively short time, the invention of entirely new and efficient processes for dealing with lead and zinc ores, either singly or combined, which have revolutionized the metallurgical practices for handling those metals.

The chief incentives to the introduction of improvements in the metallurgical treatment of mixed ores of lead and zinc were perhaps, the rewards offered some years ago by the mining companies operating on the Broken Hill field, New South Wales. For many years the principal mines on that great silver field had put aside ore too rich in zinc to be treated in the blast furnaces, and also collected immense tailing heaps carrying good values in silver, lead, and zinc. These by-products as the values of the metals advanced represented a great amount of tied up cash. According to conservative estimates made in 1905, the zinc-lead tailings in the dumps at the various mines at Broken Hill amounted to 5,700,000 tons, valued at $57,000,000. At the same time there were 10,000,000 tons of ore developed in the mines and valued at $200,000,000. This ore contained too much zinc to permit its treatment in the blast furnaces without a preceding process to separate or reduce the zinc contents and form a smeltable ore. With the view of obtaining a process capable of dealing with the refractory ores and tailings, the various companies offered large monetary rewards. These set metallurgists all the world over to work experimenting. It was not long, however, before a promising process was brought forward. Messrs. Huntington and Heberlein, while

experimenting at a lead smelter in Italy with a modification of an old lead-smelting process that had been employed for many generations in Flintshire, England, found that the premature matting of sulphides in the blast furnace could be reduced, or prevented, by mixing lime with the charge. This appeared to be a simple invention, but its development has led to the introduction into recent metallurgical works of some of the most brilliant conceptions in the history of metallurgy. These inventions apply not only to the metallurgy of lead and zinc, but also, in many instances, they may be successfully applied to the treatment of copper, iron, antimony, arsenic, and other ores.

The Huntington and Heberlein Process.

This process consists of two distinct operations: (1), heating the finely divided ore mixed with a small quantity of burnt lime in a furnace with free access of air at a temperature of about 700 degrees Centigrade, and then cooling off to about 500 degrees Centigrade, when a further oxidation occurs; (2), conveying the roasted ore while still hot to a converter. The hot blast of the converter almost completely removes the sulphur. Towards the end of the blowing the temperature of the charge is raised sufficiently to agglomerate the ore in order to facilitate its treatment in the blast furnace.

The chemical reactions which take place during treatment have not been completely determined. The inventors believed that during the lime-roasting the lime is converted partly into sulphate, while the lead is partly changed to sulphate and partly to oxide. But according to the experiments of F. O. Doeltz, the lime is partly converted into sulphate and later is changed to calcium silicate by the combined influences of the roasting and silicic acid from the silica of the ore.

Carmichael-Bradford Process.

This is an Australian invention devised by the metallurgists at the Broken Hill Proprietary mine. It consists, essentially, in charging a mixture of the lead-sulphide ore with from 10 to 30 per cent of dehydrated gypsum into a converter without a preliminary roast. The operations then are similar to those in the Huntington-Heberlein process excepting that the converter gases are collected and converted into sulphuric acid.

The gypsum is mixed with the ore and water in a pug mill. The mixture is then spread out on a brick floor and sun-dried. When ready for the converter, the latter is prepared by charging the bottom with a layer of glowing coal which forms a bed for the charge of the ore and gypsum mixture and starts oxidation. The inventors worked on the theory that calcium sulphate, or gypsum, played an important part during the oxidation of the roasting charge. But recent investi-

gations suggest that gypsum plays no such part in the chemical reactions in the converter. On heating a mixture of galena and gypsum in contact with air, lead sulphate will be formed along with some lead oxide. The lead is oxidized and then converted to sulphate by sulphuric acid by a reaction which may be formulated thus:

$$Pb\ O + SO_2 + O = Pb\ SO_4.$$

The results obtained from the operation of the large plant on the Broken Hill Proprietary Mine during the past four years have been so satisfactory that the company is at present completing arrangements for the erection of another Carmichael-Bradford plant on a much larger scale at its works at Port Pirie, South Australia, to deal with customs ore from all parts of Australia. The principal improvements in the designs of this plant are mainly in matters of automatically handling the materials during the progress of the operations. The fundamental features of the process will not be modified.

The Savelsberg Process.

An improvement on the two preceding lime-roasting processes was introduced into the Ramsbeck smelting works, near Aix-la-Chapelle, Germany in 1904 by Adolph Savelsberg. In this process a preliminary roast is made in revolving furnaces 20 to 26 feet in diameter having capacities varying from 25 to 60 tons of ore per 24 hours. The zinc from the ore passes into the fumes and is collected in the dust chambers. The converter bed is covered with a layer of crushed limestone which protects the ironwork. A layer of glowing coke is then forced over the limestone and on this is placed the mixture of ore and powdered limestone. When the blast is raised to a sufficient pressure, desulphurization commences and when completed the temperature is raised somewhat further so that agglomeration takes place. When the sulphurous fumes cease to be evolved and the charge commences to harden, the converter is tilted to dump the charge.

Savelsberg now omits the preliminary roasting when handling ordinary lead ores; he states in his United States patent specification:

"I have observed that if lead ores which are to be desulphurized contain a sufficient quantity of limestone, it is possible, by observing certain precautions, to dispense entirely with the preliminary roasting furnace, and to desulphurize in one operation by blowing a current of air through the heated charge.

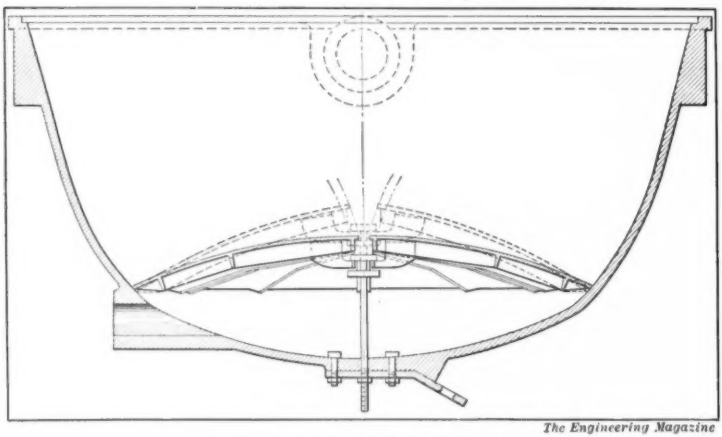
"The particles of limestone do not exert a chemical but a mechanical influence on the ore particles. They separate the mineral particles in the ore from one another in such a way as to prevent premature agglomeration. The whole mass is loosened and rendered accessible to air. The limestone, furthermore, moderates the high reaction temperature resulting from the burning of the sulphur, so that the liquefaction of the galena, the sublimation of the lead sulphide, and the separation of metallic lead are avoided."

The limestone is, nevertheless, decomposed by the process. Lime is formed and partly converted into a sulphate. When scorification

takes place the lime sulphate is converted into calcium silicate by the silicic acid present, while sulphuric acid is liberated with the fumes. This process is carried out in a plant exactly similar to that employed in the two preceding processes.

Pot Roasting.

A modification of the lime-roasting processes above described has been introduced by the metallurgists of the American Smelting and Refining Company. It was discovered during the progress of some experiments at the company's smelter at Murray, Utah, that desulphurization of lead ores may be promoted without mechanical assistance of lime or any other refractory substances. All that is necessary is to attend to the proper distribution of the blast air throughout the charge. At the Murray smelter twenty-five pots are required to handle the roasted ore from five Heberlein cylinder roasters



POT BOTTOM, FOR POT ROASTING PROCESS.
As used at the Murray Smelter, Utah. The hood is removed.

The pots employed in this process resemble sugar boilers in appearance. They are from 8 to 10 feet in diameter, and are furnished with a detachable hood connected by a movable take-off with the dust flue leading to the dust chambers. A cast-iron grate, and a baffle plate, placed within the pot enable the air blast to be distributed in even streams throughout the charge. These pots differ only in minor details from the converters employed in the Huntington-Heberlein process, and pot roasting may be described as the Huntington-Heberlein process modified by the omission of lime from the charges.

The ore to be treated undergoes a preliminary roasting which reduces the sulphur contents from 20 or 25 per cent to 12 or 14 per cent.

Each pot carries an 8-ton charge. The charge is moistened before it is run into the pot. When a pot is charged and ready to be blown, the hood is adjusted and the blast is gradually increased from 1 to 4-ounces pressure. At Murray, the ore is galena which is comparatively free from lime. The average contents of the ore treated is about 8 per cent lead, 30 per cent silica and 20 per cent sulphur. The principal weakness of this process is the time occupied in treating the ore, and also the large amount of handling the ore undergoes.

Briquetting.

In some smelting works the fine sulphides are prepared for the blast furnaces by briquetting processes. At Broken Hill, silver-lead concentrates have been successfully briquetted by:

1. Mixing the concentrates and fines with newly slacked lime and water in a pug mill.
2. Pressing the mixture into briquettes.
3. Stacking the briquettes in roasting kilns.
4. Burning the briquettes to harden them.

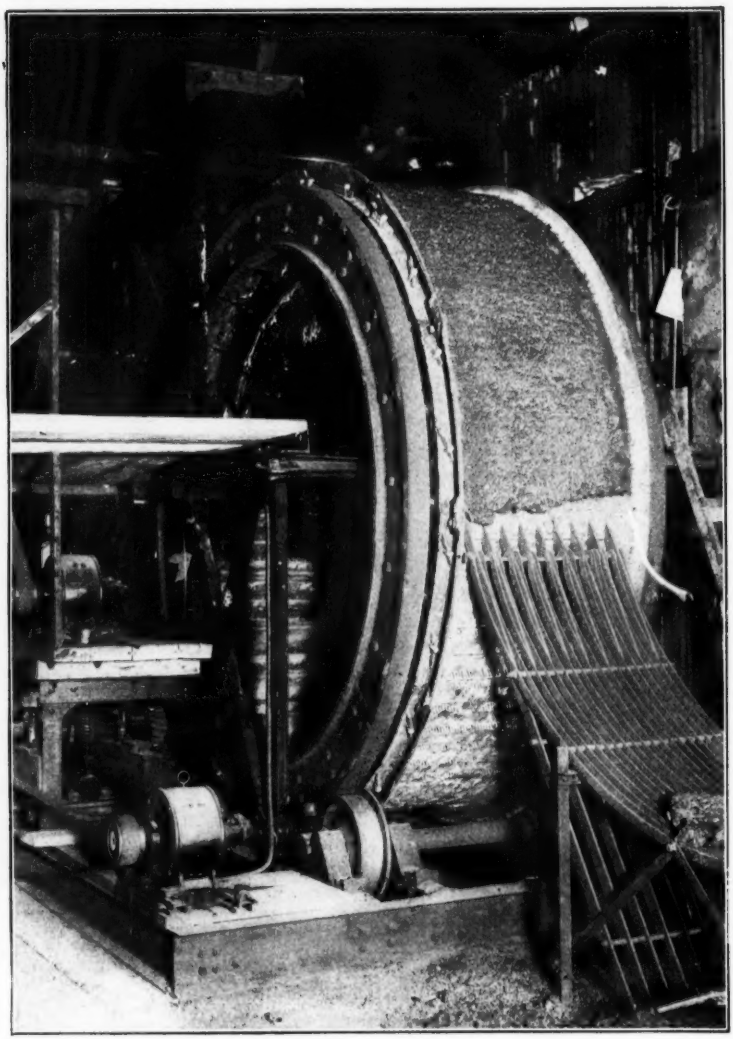
From 3 to 5 per cent of slacked lime is used and enough water to produce a clayey mixture which on being squeezed in the hands will form a stiff lump. A little sand is then added to act as a binder.

The briquettes are burnt in kilns like orinary bricks. But as the briquettes evolve large quantities of deleterious fumes while burning it is found necessary to provide the kilns with suitable doors to enable the air supplies to be properly regulated. Dust flues and chambers are also required for the preservation of the zinc and other volatile constituents of the ore.

Briquettes made of concentrates and slimes containing much pyrite, or rich in sulphur contents, require burning from 10 to 20 hours. Where they are made from roasted materials, which will not burn freely, briquetting operations are carried on with the view of sintering the material. This necessitates the kilns being fired for three or four days. By pugging the slime, running the pugged material onto a floor to dry, cutting the dried material into lumps, piling the lumps over firing foundations, and heap-roasting them, similar results are obtained. But briquetting is cheaper and more efficient. The cost of briquetting the concentrates at Broken Hill is from $1 to $1.50 per ton.

The Dwight and Lloyd Sintering Process.

As a result of investigations relating to the conditions affecting the sintering of the charges in the blast pot, Messrs. Dwight and Lloyd found that better results are obtainable when operations are conducted so that: (1), treatment is made continuous; (2), the material is kept

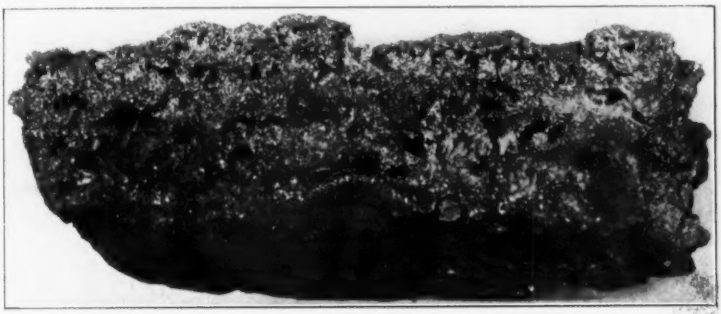


DWIGHT & LLOYD SINTERING MACHINE, DRUM TYPE, SHOWING STRIPPING GRIZZLY.

in a quiescent condition; (3), a thin layer, charge or succession of charges is employed.

The maintenance of the charge in a state of complete quiescence is essential to good sintering. It appears that to obtain the best results

all the ore particles must remain in practically the same relative position, in close contact with their neighbors, and subject to similar thermal reactions, during the period of maximum temperature at the end of the operations.



SINTER MADE FROM CONCENTRATES AND FLUE DUST.

With the view of treating ores which were not well suited to treatment by the pot-roast process Messrs. Dwight and Lloyd designed the machine shown on page 862. It consists of a revolving drum resting on rollers like a copper converter. This drum is caused to revolve slowly about its axis by the friction of the drive rollers. It acts as a conveyor of the ore as well as a roaster. Inside the drum there is a suction chamber which is connected with a suction fan. The moving rims form an air-tight joint with the edges of the stationary suction box which occupies the top quadrant of the circle inside the drum. The material to be sintered is fed in a thin layer upon the grated face of the drum from an overhead ore-hopper. Immediately the ore reaches the drum surface it comes in contact with the igniter. This is either a series of gasoline or gas jets, an oil flame, charcoal brazier, hot roasted ore, hot sinter, or anything capable of promoting the oxidation of the charge. The ignition medium acts downwards on the charge in such a way as to kindle the ore stream uniformly across the whole width of the conveyor. The roasting action started by the igniter is augmented and maintained by the steadily flowing airstreams that are sucked down through the ore layer by the suction fan as the ore drum slowly revolves across the suction box placed within the top quadrant of the drum. The ore layer is usually about 4 inches in thickness and requires about 20 minutes for the sintering action to be completed. The speed of the drum is regulated in such a way as to enable the whole layer to be completely sintered down by the time it reaches the far end of the suction box. The sintered ore is stripped from the drum and automatically discharged by the pointed grizzly.

The drum type of machine has been found in practice to be one of the most convenient for ordinary ores, but the same sequence of operations may be accomplished in other ways. The inventors of the process have used various other mechanical means for carrying out the sintering.

The cost of operating this sintering process is considerably less than that of the pot-roasting it was designed to supersede. It is simple to operate and is under complete control. The range of composition of material from which a suitable sinter can be made is wider as to silica, iron, sulphur, etc., than the limits imposed by the requirements of proper blast-furnace charges. No lime, limestone, or other substances are required to be mixed with the ore to be treated and it effectively handles the finest slime materials.

SINTER CARRYING 50 PER CENT. LEAD, MADE FROM GALENA CONCENTRATES WITHOUT LIME.

This process converts fine ore and slime into hard sintered masses suitable for smelting in blast furnaces. It also promotes economy in blast-furnace fuel, and largely increases the capacity of the blast furnace by such reduction in fuel. The sintering of the ore reduces the loss of metals by limiting the amount of flue dust. This method of sintering enables fine ores suitable for pyritic smelting to be successfully treated in isolated districts in which many of the older processes could not be utilized on account of the cost of the plant and other conditions.

The sulphur gases evolved from the ore treated on the drum are highly concentrated and can be easily controlled. It is consequently possible to utilize them for conversion into acids and other chemical compounds or to render them innocuous.

The process readily lends itself to the solution of many chemical and metallurgical problems and is capable of rendering valuable assistance in special concentrating and smelting operations. It has been successfully employed on a commercial scale for some time treating copper ores at Cananea, Mexico, and in handling other classes of ore at Perth Amboy, N. J., Baltimore, Md., and elsewhere.

Flotation Process.

Not only have the methods of smelting and of preparing ore for smelting been improved as was shown above, but the processes of ore concentration have been revolutionized also within the past few years.

When it was found that electrostatic concentrators were inefficient in dealing with the Broken Hill silver-lead-zinc ores, experiments were carried out with the view of improving wet methods of concentration. It was discovered that by using certain chemical means the well-known tendency of minutely divided mineral particles to float on the surface of water could be utilized in effecting a separation of the mineral matter from its gangue.

Potter discovered that a 3 per cent solution of sulphuric acid would so promote flotation that an efficient separation could be easily made in one operation. In his early experiments he simply ran the ore and water into long troughs, made from an alloy of zinc and antimony to withstand this acid, and drew off the floating ore in the overflow into settling pans. The concentration is now effected in specially designed Delprat pans. The ore to be treated is sized and fed into the pans with properly acidulated water. The amount of acid required varies as the zinc contents of the ore. For an ore running 20 per cent in zinc, about 40 pounds of sulphuric acid per ton of ore are required. The extraction amounts to about 95 per cent.

Delprat adds sodium sulphate to the sulphuric acid solution with the view of densifying the concentrating medium. De Bavay gasifies the ore particles by carbon dioxide obtained from furnace gases. Elmore replaces the water by oil. All these processes are now in successful operation at Broken Hill and employed in conjunction with one or other of the sintering processes described in this article they have solved the principal metallurgical problems relating to the utilization of refractory silver-lead-zinc ores. Since the installation of a Potter concentrating plant and a Carmichael-Bradford sinterer on the Broken Hill Proprietary mine in 1904, the company has been able to

utilize 691,373 tons of zinc tailings which were previously of no commercial value.

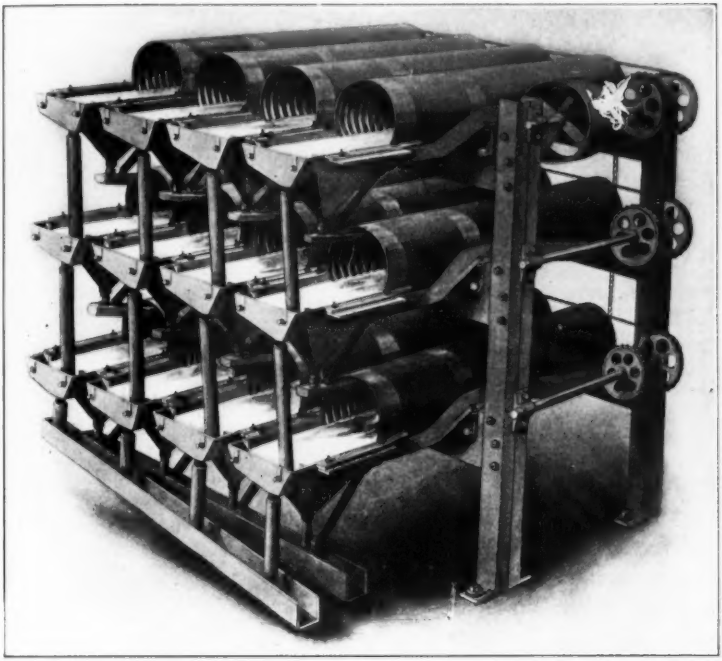
The Macquisten Process.

A recent invention by Macquisten, of Glasgow, Scotland, reduces the flotation processes to their simplest form. No chemicals are employed as in the Potter, Delprat, De Bavay and Elmore processes. The sulphide particles of ores are separated from the accompanying gangue materials through the medium of water by utilizing the surface tension of water by a simple mechanical device. The invention is based on the observation that sulphide minerals are positively affected by the surface tension of water while the rock constituents are not so affected. The surface tension of the water spreads around each sulphide particle like an envelope leaving, probably, a bubble of air between the surfaces of the water and the mineral large enough to float the sulphide. No envelope is formed around silicates. The water appears to penetrate them and causes them to sink.

The process is carried out in a concentrator composed of a simple cast-iron tube about 6 feet in length and 1 foot in diameter which weighs about 450 pounds. Near each end, externally, the tubes are cast with two tires resting on supporting rollers to enable the tubes to be revolved with the least amount of friction. Internally there is a helical groove with an inch and a half pitch running from end to end as in a bolt nut. The tube is charged from an ordinary square wooden launder and it discharges into an ordinary separating box from which the floating ore particles are flowed over an apron on the upper rim opposite the discharging end of the tube. The gangue matter is drawn off from the bottom of the box from a bung hole.

The tube is revolved at the rate of about 30 revolutions per minute. The pulp is screwed through the tube and is so guided by the helical screw groove as to give the mineral particles repeated opportunities to glide upon the surface of the water. It is found in practice that ordinarily a good concentration can be made in one tube. The inventor's experiments, however, showed that when four tubes were joined in series so that one fed into the next one following, some of the finest particles did not get properly started on the water's surface until they had nearly reached the discharging end of the fourth tube.

This process has been tried on a large scale at the Adelaide Mill, Nevada. It was run with an ore composed of chalcopyrite, pyrrhotite and pyrite with a little blende and galena which previous plants had failed to handle profitably. Each tube successfully treated from 5 to 6 tons of ore per 24 hours, concentrating in the ratio of 11 to 1.



THE MACQUISTEN MACHINE, SHOWING CONCENTRATORS ARRANGED IN SERIES OF THREE.

The top cylinder feeds into the one immediately below. American Direct Concentrating Co., Salt Lake City.

The benefits arising from the above described metallurgical inventions will not be restricted to the treatment of the ores they were specifically designed to deal with. Experience, doubtless, will show that some of them may be successfully utilized in many of the chemical and manufacturing industries. Many of the refractory zinc-lead-copper ores these new processes will be called upon to treat contain appreciable quantities of gold and silver, which they will concentrate and save. Their use, therefore, will assist in preserving the steady increase in the world's annual gold production which has been so noticeable in recent years. They will in this way become important factors in affecting the depreciation of gold and silver values, and in the consequent appreciation in the values of commercial commodities.

MANUFACTURING FROM STOCK.

By Clarence Hoyt Stilson.

It has been observed by experts in systematic works management that although stock is the most directly visible equivalent of money, its careful and intelligent maintenance, supervision, and accounting are often strangely neglected. Mr. Stilson sets forth briefly certain principles and methods which, consistently applied, will do much to reduce idle and barren investment and to increase promptness in the filling of orders.—THE EDITORS.

IN all organized manufactories the stores room plays a very important part; its functions are analogous to those of the accumulator in an electric power system, the air chamber of a force pump, the reservoir in an irrigation project. While these functions are simple and well defined, the applications of the stores room are more diversified.

Some establishments use the stores department for practically nothing but the storing of raw material; in the mammoth steel works it contains limestone, coke, ores—it is the reservoir for the incoming material, preventing freight congestion and conducing to an even, unchecked flow of finished product. Another concern will store not only the raw material but the finished product as well, and while the purpose is still the avoidance of congestion and shortage, it is with a wider significance. In the steel works, minimum cost of production is sought by assuring maximum output; in other lines of business low cost of production is not sufficient to insure a healthy volume of trade; quick delivery must also be assured. As a consequence, a considerable store of both raw and finished product is maintained, so that, when necessary to meet competition, very quick delivery can be made either from the stock of finished goods or by rushing manufacture, using material on hand in the stores.

This practice of making prompt shipment by the aid of stock carrying has grown until the trade have been literally trained to expect and often to demand it. Furthermore, the very nature of certain classes of manufactured articles necessitates exceedingly prompt shipments; the demand for certain novelties may last only sixty days, making it imperative to get the goods on the market inside of a week or two. At any rate, both through the demands of the trade and through the endeavor of manufacturers to outdo one another in offer-

ing inducements to buyers, the conditions above described have come and are apparently here to stay. Manufacturing concerns are helpless in this matter, and must submit to some loss due to investment in raw material and finished goods, as a necessary contingency.

Brass Rod – ½" diameter
Temper-soft
AVAILABLE Min. 4500 Max. 9000

RECEIVED				WITHDRAWN				IN
Date	Order	Amount	Total	Date	Order	Amount	Total	STOCK
3/8/08	187186	9000	9000					9000
				3/10	E 23478	750	750	8250
				3/18	E 24176	2300	3050	5950

The Engineering Magazine

FIG. I. SIMPLE FORM FOR STOCK RECORD.

There are some factories where practically every order received entails only the assembling and finishing of standard parts made up in advance and stored in stock, which process we may call "manufacturing from stock." Manufactories of screws, shoes, metal buttons, etc., are organized to operate along this principle. Orders for these goods are received in great quantities, each of comparatively small value financially, and to attempt to put each lot separately through the works from raw state to completion would result in excessive high cost of production, great delay, and costly clerical work. This method, though proper and necessary in a machine-tool works, is entirely wrong in a shop manufacturing from stock.

Maximum _____
Minimum _____

Ordered				Applied				Available	Received				Withdrawn				In Stock
Date	Order	Amount	Total	Date	Order	Amount	Total		Date	Order	Amount	Total	Date	Order	Amount	Total	

or throttle from time to time, with perhaps a general readjustment once a year or when abnormal conditions present themselves.

Turn to Figure 2. This gives total quantities received, withdrawn, and left in stock. More than this—it shows the quantities ordered to replenish stock but not yet received, also every customer's order on which any stock goods have been applied. From this a moment's study will give a complete story of the past and present business on any type of product. In the upper portion appear the Stock Limits, which are the "indicators" by which the condition of the stock may be judged and by the help of which the amount of stock on hand is kept within bounds. The figures appear insignificant and of no especial value to the layman, but they should represent not a little sober thought and an analysis of market conditions both conservative and progressive.

When the amount in stock drops to the minimum stock limit, orders are to be entered at once to replenish the stock; the amounts of these orders should be such that at no time does the total quantity of unapplied goods in stock exceed the maximum limit.

The limits themselves are based first on the present and past demand, and second on the time required to obtain or to manufacture the goods necessary to replenish the depleted stock. If the rate of consumption, as indicated by the records, of a certain size of brass rivet rod is 3,000 pounds per month, and six weeks are required to obtain any of this material after placing an order with the mills, then a minimum stock limit of 4,500 pounds is absolutely necessary; likewise a maximum limit of 9,000 pounds would seem quite safe. By placing an order for the maximum limit the very day the minimum is reached, we should receive 9,000 pounds on the date on which the stock would theoretically be entirely consumed.

Using these methods, the stores keeper is supplied with a list of goods to be carried in stock and is authorized to maintain this stock within the limits set, which renders unnecessary much anxiety on the part of the management as to the handling of future business and does away with the disorganization accompanying the fulfilment of rush orders for which otherwise the factory would be unprepared.

There still remains on the shoulders of the factory management one duty which must not be neglected, and that duty consists of a constant censorship of all orders for replenishing the stock. As a part of this duty may be considered the periodical study of the entire stock, a thing that may be done very quickly and comprehensively by means of charts such as are shown in Figure 3. (Page 872.)

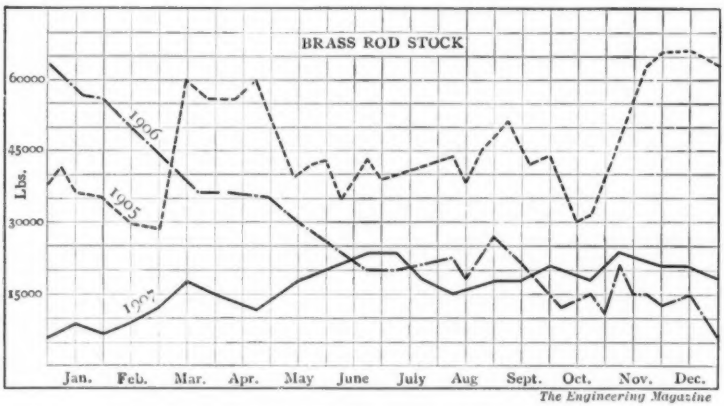


FIG. 3. GRAPHIC RECORD OF BRASS ROD IN STOCK.

The curve indicates that throughout the year 1905 an average of about 40,000 pounds of screws was maintained. In April and December the stock increased very noticeably, the rise in December being rather unfortunate in view of the imminent January inventory. The following year (1906) under systematic organization of the store-house records, the stock was rapidly reduced and held in good control all through 1907.

These charts are taken from the stores-room records, the totals of all classes of goods being taken every Monday morning and plotted as indicated. For purposes of comparison there is nothing more satisfactory than such charts, a number of things being indicated by the simple curves. They give present investment as compared with that of preceding years and months; they indicate in what lines business is the heaviest; and they give a history of the fluctuations in supply and demand for the past few years. But their chief use is the control of investment in stock, and with intelligent use they should permit the present-day manufacturer to practice "stock carrying" more extensively than ever before, with the consequent benefit of being able to make prompt shipments and the freedom from the danger of excessive accumulations of material and goods.

In other words, the stores room, instead of becoming simply a "catch-all" for defective work, useless goods from cancelled orders, and all such odds and ends, can be made a most efficient tool and a powerful resource for profitable manufacturing.

ALCOHOL AS A FUEL FOR INTERNAL-COMBUSTION ENGINES.

By Thos. L. White.

Mr. White's first paper was published in the August issue of THE ENGINEERING MAGAZINE, and was devoted to a review of the present state of the production of industrial alcohol and to a very interesting proposition for its manufacture at low cost and on a large scale from sources of almost unlimited abundance. This concluding paper examines the differences between alcohol and gasoline as combustion-motor fuels, the changes in design or practice necessary to adapt alcohol to general use in this field, and the advantages which may be thus secured.—THE EDITORS.

IN a preceding article the practicability of obtaining commercially ample supplies of fuel alcohol was examined, and the apparently sufficient answer afforded by the Lagerheim-Frestadius process was presented. On the principle that when the problem of catching the hare has been solved, there remains the problem of cooking it, we now come to consider the suitability of alcohol as a gasoline substitute. As there are many types of engine designed to fill widely varying needs, the subject is one which has many sides and may easily be made confusing or misleading unless the issue under discussion is very clearly defined. As an example of the kind of argument which too often passes current, and by causing motor users to expect the impossible does the prospects of fuel alcohol endless harm, we quote the following, which formed part of a paper read at a scientific meeting, and which, besides exemplifying the class of fallacy to be guarded against, will also serve to put on record the principal data of the fuel question so far as alcohol and gasoline are concerned.

"Comparing denatured alcohol and gasoline as at present in use:—

Gasoline, specific gravity, 0.72; net British thermal units per pound, 19,600.
Alcohol, specific gravity, 0.82; net British thermal units per pound, 10,600.

The heat units converted into work, taking the efficiency of the alcohol engine to be 35 per cent, and that of the gasoline engine to be 20 per cent, would be:—

Gasoline; useful British thermal units, 3,920.
Alcohol; useful British thermal units, 3,710.

Allowing for the difference in specific gravity, we find that the useful numbers of British thermal units per gallon are:—

$3{,}920 \times 0.72 \times 8.3 = 23{,}246$ for gasoline.
$3{,}710 \times 0.82 \times 8.3 = 25{,}259$ for alcohol.

Taking the price of gasoline at 15 cents per gallon, we could even pay 16 cents per gallon for alcohol, and obtain an equal amount of energy for the same expenditure. Or, we may say that it is possible to get with a properly designed

alcohol engine a greater mileage per gallon of alcohol than with gasoline in the best designed engine."

From a logical point of view, or as regards the data and the calculations based on them, there is no fault to find with the foregoing argument. It is the underlying assumption that is misleading. What is not stated is that the alcohol motor for which an efficiency of 35 per cent is quoted is of a heavy stationary type, having a rate of only one hundred revolutions a minute, a ratio of stroke to bore of over two to one, and an initial compression in the neighborhood of 200 pounds to the square inch. Now, no such engine ever has been, or probably ever will be, put into an automobile, and to claim a greater mileage per gallon for alcohol than for gasoline on the strength of such a record, made it may be said under laboratory conditions, is very much the same thing as claiming that because the Diesel motor will burn crude petroleum and render an efficiency of 36 per cent, therefore crude petroleum is a better fuel for the automobile than gasoline.

In considering the difficult matter of changing over from gasoline to alcohol, it is important to remember that the two fuels differ in a dozen essential particulars; that the current type of motor is a gasoline instrument evolved under gasoline conditions; and that the greatest variety of opinion exists as to how far the accepted rules of construction will have to be modified to suit the change. Moreover, there is the important economic fact to be considered that some millions of gasoline motors are at present in use, and that it is not only a sound but a necessary policy to try to maintain their constructional features as far as possible, changing nothing unless there is a distinct necessity for each change, or a distinct advantage resulting from it. That there are to be had special alcohol machines, which are excellent for certain purposes, is beside the real issue which is concerned with using alcohol in the high-speed, low-compression engine.

We are all familiar with the fact that in the courts very little importance is attached to expert testimony, for the reason that for every eminent expert who can be brought to prove that A is B, another slightly more or less eminent expert can be brought to prove that it is nothing of the kind. While conceding that the chief offenders seems to be the medicals, and that mechanical engineering is less elastic in its conclusions than medicine (possibly because the engineer's failures remain to reproach him, while the doctor's do not) it is nevertheless astonishing how difficult it is to get a definite, clear-cut decision on a debatable point when we come to collate the

conclusions of the different committees that have examined the fuel question. And on no issue, judging by the following extracts from the reports of several recent investigations, is there more variety of opinion than on the question of using alcohol in the gasoline motor.

As has been previously published, alcohol can be used with more or less satisfaction in stationary or marine gasoline engines, and these engines will use from one and one-half to twice as much alcohol as gasoline when operating under the same conditions. The possibilities, however, of altering the ordinary gasoline engine as required to obtain the best economies with alcohol are very limited, for the amount that the compression can be raised without entirely redesigning the cylinder head and valve arrangement is ordinarily not sufficient nor the gasoline engine usually built heavy enough to stand the maximum explosive pressures, which often reach 600 and 700 pounds per square inch.—*Report of the Technologic Branch of the U. S. Geological Survey.*

From the previous argument it will be seen that, in order to utilise alcohol in an internal combustion engine, certain modifications in the engine itself become necessary, but it is quite reasonable to expect that such alterations would become unnecessary if a proportion of tar benzol, acetylene, or other hydrocarbon, containing a high percentage of carbon were mixed with the alcohol. Owing to this high percentage of carbon present, the chemical composition of the mixture will be brought more nearly to resemble those of petroleum products. As to the most suitable relative proportions, experiment only will determine these, but such a fuel as is here suggested has the advantage that it can be used without material alteration to the engine.—*Report of the Fuels Committee of the Motor Union of Great Britain and Ireland.*

As for the difficulty of starting from cold, it will be probable that alcohol as a fuel will almost always have a greater or less quantity of benzol mixed with it, in which case this difficulty entirely disappears. Even without the addition of benzol there is little doubt that the question of starting from cold will be almost entirely overcome by the use of a suitable carburettor.—*From the same Report.*

Any gasoline engine of the ordinary types can be run on alcohol fuel without any material change in the construction of the engine. The only difficulties likely to be encountered are in starting and in supplying a sufficient quantity of fuel, a quantity which must be considerably greater than the quantity of gasoline required.—*Report of the Office of Experimental Stations of the U. S. Department of Agriculture.*

It will be seen that inferentially three distinct views can be based on the above findings:

1.—Material structural changes are necessary.

2.—Material structural changes are unnecessary if the alcohol is blended.

3.—Material structural changes are unnecessary.

Which view is adopted depends a good deal on the importance attached to the superior economies obtainable by high compressions. Viewed from a practical standpoint, such gains are capable of being much overrated. In the first place high compressions can rarely be maintained under ordinary working conditions. In the laboratory or the shop, where expert attention is always available, a high-pressure engine can be continuously operated at its top notch of efficiency; but in daily use in the factory, on the farm, or on the road, from the lack

of constant skilled supervision, the compression will be gradually lost owing to the heavy duty imposed on the piston rings and valves. When this occurs the result is simply a low-compression engine having all the extra weight and unhandiness of a more complex type. Then, again, as has lately been pointed out by Mr. Sidney A. Reeve, the evolution of engine types in the past has not been so much along the lines indicated by considerations of fuel economy as along the lines indicated by considerations of handiness, reliability, and flexibility. If alcohol possesses advantages of this character, when burned in the present type of gasoline motor, and if any operative disadvantages incidental to its use (such as difficulties of starting up) can be eliminated, and some increase of efficiency attained by recourse to less radical means than high compressions, then there will be no need to consign the present engine to the scrap-heap in order to be able to burn alcohol. It is the opinion held in this article that alcohol has several such advantages, and that its efficiency in the gasoline motor can be increased without virtual reconstruction, and the grounds for this belief will now be set out. Incidentally, it is well to remember that in the matter of compression there is no golden mean. The gasoline engine compresses to 80 pounds at most, and till this is increased to over 130 pounds, the gain in thermal efficiency resulting is not worth the trouble of the alteration.

While it has always been the aim of designers to make the gasoline motor as flexible as the steam engine, the narrow range within which a charge of gasoline and air can vary in composition and yet remain explosive has always prevented any regulation of the power by the manipulation of the mixture. In the case of alcohol and air, however, the variation of the proportions compatible with perfect combustion is four times as great, and it has been determined by experiment that the specific power of the working stroke of an alcohol engine can be reduced to 25 per cent of maximum, by the operation of an auxiliary air throttle. In automobile practice this means that the adoption of alcohol would tend towards fewer cylinders and simpler gears. The actual limits within which alcohol and gasoline mixtures are respectively explosives are 4 per cent to 14 per cent, and 2 per cent to 5 per cent, tested at atmospheric temperatures and pressures.

When one pound of absolute alcohol and one pound of gasoline (hexane) are completely burned, each in a suitable motor, the following numerical relations are independent of the type of motor used, and consequently have the character of constants.

ALCOHOL.

Minimum sufficient amount of air .	= 9 lb.	
	= 117 cub. ft. at 15 C. and 760 m.m.	
Carbon dioxide in the exhaust . . .	= 1.9 lb.	
	= 15.9 cub. ft. at	do.
Nitrogen in the exhaust	= 6.9 lb.	
	= 90.6 cub. ft. at	do.
Water condensed from the exhaust .	= 1.2 lb.	

GASOLINE.

Minimum sufficient amount of air .	= 15.3 lb.	
	= 198.9 cub. ft. at 15 C. and 760 m.m.	
Carbon dioxide in the exhaust . . .	= 3 lb.	
	= 25.1 cub. ft. at	do.
Nitrogen in the exhaust	= 11.8 lb.	
	= 155 cub. ft. at	do.
Water condensed from the exhaust .	= 1.5 lb.	

Of course in ordinary practice more air than the theoretical minimum is admitted with the fuel, but taking such excess of air as pro rata in either case, the most noticeable feature in the above figures is the relatively greater amount of nitrogen per pound of fuel which passes through the gasoline motor. The exact effect of this extra dilution, amounting to at least five pounds of inert nitrogen to every pound of gasoline burned, is somewhat obscure; but so much at least is clear—that its presence means additional loss of heat at the exhaust, and has a tendency to cause incomplete combustion, besides thermodynamically lowering the efficiency of the cycle. The obnoxious smell from the exhaust of a gasoline motor, due to the escape into the atmosphere of unburned hydrocarbons, is largely an effect of its retarding action during combustion; while on the other hand, the odorless character of the products of combustion of an alcohol motor points to the absence of the damping effect of an excess of inert nitrogen in the mixture. The fact that deposits of soot in the cylinder are the rule with the gasoline motor and the exception with the alcohol motor may be similarly explained, for although it is true that there is more carbon in gasoline to be deposited, yet analyses of the exhaust gases from gasoline motors made by Sorel in Paris in 1903 show that the proportion of unburned carbon is no greater than the proportion of unburned hydrogen, the inference being that if the hydrogen was completely burned, as is the case in the alcohol motor, the carbon would be burned as well, and the fact that neither is completely burned points to the action of some retarding influence during the period of inflammation in the cylinder, which is present in the gasoline motor but absent in the alcohol motor.

The alcohol motor has been freely criticized because of the alleged difficulty in the matter of carburation which is occasioned by the high latent heat of the alcohol. It is difficult to see wherein the drawback

from this cause exactly lies, and as far as one can tell the criticism seems to arise from the widespread notion that all preheating of the in-going charge is prejudicial to the efficiency of the motor. The fact is that preheating the mixture *after* the fuel is in a state of vapor is harmful in two ways:—

1.—The whole body of the ingoing mixture being thereby expanded, the actual weight of mixture that enters the cylinder during the suction stroke is decreased, so that the specific power of the motor is lessened.

2.—The efficiency of the motor is reduced, for while there is no lessening of the negative work done during the compression stroke, the energy of the succeeding expansion stroke on which it is a pro rata tax is less, there being less fuel present.

Preheating the mixture, however, or its constituents separately, within limits and before the fuel (in this case alcohol) has become converted into vapor, has no tendency whatever to rarefy the charge, and is consequently without effect, at any rate on that score, on either the specific power or the efficiency of the motor.

The amount of heat necessary to convert 90 per cent alcohol into vapor is nearly 6 per cent of the total amount of heat liberated by the alcohol when it is burned, and the lowest temperature at which the vaporisation can be completely effected is somewhere in the neighborhood of 75 degrees Fahrenheit, the exact figure depending on the amount of moisture in the atmosphere at the time. Now, assuming, which is the general estimate, that 30 per cent of the energy liberated in the explosion of a gas engine escapes as heat through the exhaust, we have a fund of waste heat, 20 per cent of which can be returned to the motor in a latent state with the in-going charge, without sensible rise of the temperature, once the alcohol is vaporised, and without the weight per volume of the mixture being any more affected than in the carburation of air with gasoline. What may be the exact function of this latent energy of separation of the alcohol particles thus introduced into the motor it is difficult to surmise, but on no hypothesis can its presence be construed as harmful.

To the question of carburation is closely related the question of starting up from cold. The alcohol motor has been widely attacked in this connection and as widely defended, and the only satisfactory course seems to be to disregard all evidence of a merely general character. Even specific cases cannot be regarded as having much weight, unless the accompanying conditions were normal, for the pertinent issue is not whether a start can be made from cold under the

most favorable conditions, but whether a start can be made under any conditions that are likely to occur in practice. The question also seems to be a separate one for each type of motor, technically, because the character of the difficulty to be overcome varies with different constructions, practically because the matter is of more importance in the case of the automobile engine than in the case of the stationary engine.

As they constitute a class in themselves, being unsuited to burn gasoline, the high-pressure German motors may be considered separately. According to the principle adopted in vaporising the fuel, they fall naturally for the present purpose into two divisions respectively typified by the Durr motor, in which preheat is relied on, and by the Deutz motor, in which the alcohol is sprayed into the ingoing air, vaporisation being effected by the aid of the heat generated during the compression stroke. In neither case can a start be made from cold, for in the one the necessary preheat is wanting, while in the other the compression by hand is too slow to volatilise the alcohol in the mixture.

In the case of the low-pressure or gasoline motor, it is impossible to make any accurate subdivision, the type varying all the way from the farm motor with a rate of 100 revolutions per minute and a ratio of stroke to bore of two to one, to the fastest automobile motor with a rate of 2,000 revolutions and a ratio of stroke to bore of one to one. Carefully conducted experiments go to show that when the speed is moderate and a good expansion is provided for, the gasoline motor will start up from cold on alcohol under laboratory conditions, but there is little evidence to prove that any gasoline motor can be set in operation with alcohol when the circumstances are unfavorable, as for instance in moderately cold weather. So far as the fast-running type is particularly concerned, the problem is not so much to be able to start up at all times and under all conditions on alcohol, as to be able to run at all on this fuel with any show of efficiency, and there are many reasons for agreeing with the conclusion of the Fuels Committee of the Motor Union, quoted above, that the solution lies in blending the alcohol with benzol or acetylene, not merely to facilitate starting up, which is regarded as an incidental gain, but to bring the alcohol nearer in character to gasoline so that it can be used under the gasoline conditions by which the limitations of the ordinary motor are determined.

The principal difficulties experienced when alcohol is used in the high-speed motor arise from the fact that this fuel ignites slowly, compared with gasoline, and that, when ignited, the propagation of

the flame throughout the mixture is not sufficiently rapid to suit a piston velocity of over 12 feet per second, and a piston travel which, at any rate in the case of the automobile motor, is strictly limited in range. The disadvantages, direct and indirect, which result from this sluggish ignition and tardy inflammation are several, and all important.

1.—Combustion, instead of being completed when the compression and temperature are greatest, is continuous during the entire expansion. From a thermodynamical standpoint this means that a portion of the heat units contained in the alcohol are not being liberated to the best advantage. Let T be the absolute temperature of the burning mixture at the beginning of the expansion stroke when combustion is well under way, and let T′ be the absolute temperature when the exhaust valve opens. Then the theoretical efficiency for that part of the fuel which is burned at temperature T is $(T-T') \div T$. The theoretical efficiency corresponding to heat subsequently liberated during the expansion, say at a temperature T″, which is necessarily less than T and greater than T′, is $(T''-T') \div T''$. As this quantity is always less than $(T - T') \div T$, and diminishes continuously with T″, it follows, assuming the combustion to be continuous throughout the stroke, that the thermal efficiency with which the successive portions of alcohol are burned declines all the way from maximum when combustion begins to zero when the expansion is complete.

It has been claimed for the alcohol motor that this phenomenon of delayed combustion is a positive advantage, giving a smooth, even thrust on the piston and a high mean pressure. That such an effect has been observed in alcohol motors is beyond doubt, but it must be attributed, not to the sustained inflammation, since it is most noticeable in very slow-running motors in which combustion is completed during the early portion of the expansion stroke, but to the presence of steam produced from the burning of the alcohol and from the water with which this fuel is always diluted. Provided that this steam (which is of course superheated almost up to the dissociation point) receives its heat content at the maximum temperature of the expansion, its presence and action is in every way an advantage, for it represents internal as against external cooling of the cylinder walls, and the retention of heat units in the working fluid, which would otherwise pass into the water jacket. If, however, the superheat of the steam is regenerated as the expansion proceeds by the continued burning of the fuel, this regeneration is effected at the cost of the ther-

modynamic loss stated above, a loss which is avoided if the steam receives its whole energy at the beginning of the expansion.

2.—The imperfect combustion of alcohol under the conditions which obtain in a high-speed motor is favorable to the formation of compounds deleterious to the cylinder walls and valve seats. In America, as in most countries, fuel alcohol is methylated, and methylated alcohol, besides usually containing acetone, has a tendency during the compression stroke to form this compound, which during the expansion stroke is partially oxydized to acetic acid. The extent to which acid by-products may increase by their corrosive action the wear and tear of the moving parts of the motor has been the subject of some dispute, but in any case it can be shown that the amount of acid that is formed is proportional to the amount of acetone present in the unburned mixture.

3.—To the credit of delayed combustion must be laid not only work losses due to a portion of the fuel being burned to a disadvantage, but also losses due to a portion of the fuel being only partially burned or not burned at all. The exhaust is found to be contaminated with products of combustion other than water and carbon dioxide, and ceases to be odorless and unobjectionable.

Once it is clear that the problem of substituting alcohol for gasoline as a fuel in the high-speed motor reduces itself to seeking a more vigorous ignition and a more speedy inflammation, and conceded that these desirable ends can be attained by the addition to the alcohol of some compound which will generally accelerate its action in the motor, the natural suitability of acetylene as a corrective can hardly be overlooked. This gas, which has the same formula of composition as tar benzol, has the further property which is shared by no other fuel, that it is an endothermic compound. In its formation heat is absorbed, and there resides in the acetylene molecule the power of spontaneously decomposing and liberating this heat, if it is subjected to a temperature or pressure beyond the capacity of its unstable nature to withstand.

If the liberation as heat of the reserve energy of acetylene (which, it should be noted, is an operation quite distinct from combustion, in that it can take place in the absence of oxygen) is effected when the acetylene is diffused throughout the body of an inflammable mixture, it is found that each detonating molecule of acetylene becomes a center of inflammation and the whole mass is burned with a speed and vigor which is only limited by the proportion of acetylene present. In the case of alcohol the practical question is whether the

conditions favorable to the spontaneous decomposition of acetylene are induced, when air carburated with alcohol and acetylene is compressed and ignited in the motor in the usual way; and the experimental answer is that they do. The rise of pressure set up in the mixture when the ignition takes place is accelerated by the detonation of the successive portions of acetylene as they are involved in the advancing pressure wave, and it is found that the ignition line in a pressure-volume diagram taken on a motor burning a mixture of alcohol and acetylene is even at 2,000 revolutions as vertical as the corresponding line in a pressure-volume diagram taken on the same motor when it is burning gasoline.

Mention has already been made of the fact that acetylene and tar benzol have the same empirical formula, viz., C_6H_6, and in the recommendation of the fuels committee quoted above they are coupled together as equally suitable fuels to mix with alcohol, on the common ground that their calorific value is high and that they are rich in carbon. Now, although the admixture of benzol with alcohol makes a true gasoline substitute, and although as an ingredient in *alcool carburé* benzol has been tried out with considerable success in France, the fact that it is not an endothermic compound, and that consequently it has no effect on the combustion of the alcohol with which it is mixed similar to the detonating action of acetylene, renders it inferior to that gas as a corrective for alcohol; and that there are limits to its usefulness in this capacity is plainly stated in the following extract from a paper by Herr Fehrmann, one of the leading German authorities on the alcohol motor.

> Other means for rendering alcohol suitable for use in vehicle motors consist in the admixture with the alcohol of other fuels which are calculated to overcome the difficulty of ignition. It has often been proposed to mix alcohol with other fuels of high calorific value, as, for instance, benzol or ergin, and thus to increase its heating value, and above all its inflammability. With slow-speed motors good results have been obtained in this manner, but with high-speed motors new difficulties arose as a result of the impossibility of completely burning these mixtures, so that there was a great deposit of soot in consequence of the admixtures.

Another trouble is that the amount of benzol necessary to change the character of the alcohol materially is very considerable, amounting in the case of *alcool carburé* to 50 per cent, a proportion doubly objectionable because the cleanly properties of the alcohol are entirely lost and because benzol is a product of which the sources of supply are too limited and the minimum possible price of production too high for it to come into extensive use.

The depositing of soot, mentioned by Herr Fehrmann, never occurs when acetylene is substituted for benzol, for in the first place the necessary amount of this gas to secure a quick ignition and a rapid inflammation is small, and in the second place even if this were not so, the latent energy of the acetylene would ensure the complete combustion of both itself and the alcohol in spite of the necessity for more air in the mixture due to the extra carbon in the acetylene. In the case of benzol it is the presence of this additional but necessary air that causes the combustion to be incomplete, for reasons that were explained in the early part of the article, when it was shown that the introduction of an excess of nitrogen in the motor leads to the undesirable effects mentioned by Herr Fehrmann.

Acetylene, as is evident from its formula, is a reducing agent, and its presence during the combustion of alcohol will either prevent any acetone present from forming acetic acid, or if the acid is formed, instantly reduces it to carbon dioxide and water.

All denatured alcohol contains a percentage of water, and it is a fact that alcohol containing from 10 to 15 per cent of water is in every respect a better fuel than pure alcohol. The action of the water is very obscure, and it has not been satisfactorily determined how far the percentage can be increased without the consequent lowering of the calorific value of the mixture more than offsetting the benefit in the motor. What is relevant here is that the advantages derived from the presence of comparatively large percentages have been principally experienced in connection with high compressions, and to get similar results in the low-compression high-speed motor, the damping effect of a large admixture of water calls especially for the accelerative action of acetylene on the inflammation and ignition.

In conclusion, if we consider that the automobile motor is an instrument in which power must be sought by high piston velocities, and that starting with Daimler's motor this condition has been accepted without question as the basic canon of construction of this class of engine, it seems almost inevitable that the use of alcohol, in the automobile field at any rate, will continue along the lines of carburating the alcohol, of which the French *alcool carburé* is an example and a step. Of the two ways of bringing Mahomet and the mountain together it is the best way in the end to transport Mahomet, even if the road be somewhat difficult and a little preliminary exploration be called for.

THE FEED-WATER SYSTEM FOR THE POWER PLANT.

By Charles A. Howard.

Mr. Howard's summary includes broadly all the more important elements of boiler-feed practice—supply, economy, appliances and lay-out. Following it very soon we shall present a full discussion of the subject of feed-water heating, by Reginald Pelham Bolton, in which the various methods of heating by hot gases, live steam and waste steam are carefully worked out and the heat balance is exhaustively studied.—THE EDITORS.

ONE of the most important considerations, if not a vital one in the steam-power plant, is the system for supplying feed water to the boilers. A supply of reasonably clean water must be available at all times, and the system should be so designed that the failure of some piece of pipe or apparatus will not shut down the whole plant.

The fundamental point in the design of such a system, and one too frequently neglected, is the supply of water to the station itself. It is not uncommon to find a power plant equipped with the most up-to-date apparatus and the most carefully designed duplicate systems inside of the station, but with the sole water supply coming through a single line of pipe. There are, of course, cases where the single line is all that can be obtained; but there are many more where additional sources of supply could have been provided at a slight expense. Plants running condensing sometimes use the same source of water for circulating purposes as for the boilers, but when the circulating water is unfit for boiler use on account of salt or otherwise, and the feed water is taken from elsewhere, a connection should always be made so that in cases of emergency the kind of water used for circulating purposes can be used to feed the boilers.

After having made sure that the supply of feed water is adequate and certain, attention can be turned to the design and layout of the piping and apparatus inside of the station. At the very start, there are several fundamenal questions to be settled, each involving a careful study of the existing conditions, not only as they are at present but also as they will be in the future. There is the question of economizers; shall we install them or shall we not? Shall we use heaters, and if so are they to be open or closed? Are our auxiliaries to be steam or electrically driven, and if steam-driven shall we take any

pains to secure especially good steam economy? The conditions of the individual problem are the governing factors in all these questions, and it can not be stated in general that one side of any of them is the better.

Let us first consider the economizer question. On looking over some of our largest plants designed by the most capable engineers, we find economizers installed; in other plants, which are the work of equally good men, no provision is made for them. There is a great diversity of opinion in regard to the maintenance of economizers; some who have had a large experience with them consider that the maintenance costs are very low, while others find them extremely excessive. I find pretty generally that the cases where the cost of upkeep has been high are in plants where the load factor is low. In looking over existing plants, it will be noticed that the economizer is very popular in mill plants and manufacturing plants, less so in railway work where the load factor is lower, and still less in lighting plants which have in general even a lower load factor than the railway plants.

In plants where the main generating units are run condensing, and where there is a demand for the exhaust steam of the auxiliaries for heating, drying, or other purposes, or where the auxiliaries are electrically driven, an economizer is a practical necessity for heating the feed water. Under other conditions than these just given, it is doubtful if any better results can be secured by an economizer than can be produced by a well designed system of auxiliaries and heaters making all together an installation of less first cost and less maintenance, and taking up less space, not to mention the effect of the economizers on the chimney draft. This last matter is no small item, especially where the tubes of the economizer are staggered. If the plant is operated by induced draft, it is a simple matter to speed up the fan and obtain the required draft provided the fan has sufficient capacity; but when forced or natural draft is in use this cannot be done, as if the forced draft fan is speeded up to any extent it will produce a pressure over the fires on account of the reduction of draft by the economizers making it impossible to take the volume of gases away. This pressure will very soon cause the boiler fronts to be burned. This is frequently the reason for the capacity of the boilers falling very materially after economizers have been installed.

When it comes to the question of choosing the type of auxiliary heater, there is some difference of opinion. In general, however, it may be safely stated that except in very unusual circumstances,

the open heater shows up more favorably than the closed tubular heater for the following reasons.

First: The open heater saves the substance and heat of the condensed exhaust steam which amounts to as much as one-seventh of the total boiler-feed supply. The tubular heater throws this water and its sensible heat away, amounting to as much as 130 B. t. u. per pound above water at 70 degrees F.

Second: The capacity of the open heater is always the same; but the closed heater, after it has been in operation for some time, is sure to have its capacity reduced by the deposit of oil on the steam side of the tubes and the collection of scale on the water side.

Third: The open heater is usually operated under a very slight pressure, generally less than two pounds, while the tubular heater is subjected to a greater pressure than the boiler itself.

Fourth: The salts in solution in the water have each a temperature at which it is deposited, and this temperature is reached in the open heater while the water is dropping down from one tray to another, while in the tubular heater it takes place in the tubes, causing heavy scale deposits.

Fifth: The open heater has a large settling chamber and filter which catch the mud and floating impurities that would otherwise pass on to the boilers were a closed heater used.

The open heater, however, must be equipped with an effective oil eliminator, as practically no oil should be allowed to pass into the boilers. There are several good makes of these separators which prevent the passage of any appreciable amount of oil through them.

In selecting pumps and engines for the station auxiliaries, the condition rarely occurs in which it is worth while to strive for any great steam economy. The upkeep and first cost on simple engines and pumps are much less than on compound; in some cases the extra cost of maintenance of the latter will make up for the steam saved over the former where the exhaust is not used for feed heating. When the exhaust is used for feed heating and there is need for the extra steam, it is bad policy to install high-efficiency auxiliaries where these involve added complexity of parts. Recently, turbine-driven centrifugal pumps have been very successfully applied as boiler-feed pumps and condensed water pumps, and their low cost of maintenance and the fact that they need practically no attention ensure for them a large increase in their use. The pressure in the feed lines fed by centrifugal pumps is practically constant, while with direct-acting pumps, when several of them get into unison and a large num-

ber of the feed valves of the boilers are closed, the variations in pressure are very large. In one case, I have noted a differnce of 85 pounds between the maximum and minimum for five minutes.

Most of the advocates of driving the auxiliaries by electricity use the very plain and simple argument that the electricity is generated by an engine which uses say 12 pounds of steam per horse-power hour, while the auxiliaries will consume from 20 to 60 pounds per horse-power hour; and as the efficiencies of the motors and generators are each 85 per cent or more, and the transmission losses small, they figure a large saving for the electrically driven machines. Plant economy in pounds of steam not only means nothing but is in general very deceptive, giving on the surface results which are greatly in error, as this instance will show.

In an economical condensing engine running at 12 pounds per horse-power hour at 175-pounds absolute steam pressure, 17.7 per cent of the heat in the steam is delivered by the engine, the remainder being rejected to the condenser or otherwise lost. With the steam-driven auxiliaries exhausting into an open heater, the only loss of heat, and hence of energy in the system, is that due to friction and radiation from the piping, which if covered will total less than 10 per cent. This leaves 90 per cent of the heat utilized as against 17.7 per cent with the electric auxiliaries, making a loss of 82.3 per cent in one case and 10 per cent in the other. This would allow of a steam consumption by the auxiliary machinery roughly of 82.3 ÷ 10 or 8.23 times that of the main engines for equal economy, other things being equal.

To show this point up a little more plainly, let us take a concrete case. Say the auxiliaries of a given plant whose main engines run condensing require 300 horse power to drive them. Let the steam consumption of the main units be 12 pounds of steam per horse-power hour at 175-pounds absolute, and take the average consumption of the auxiliaries, both pumps and engines, at 60 pounds of steam per horse-power hour, which is a very high figure. Which is the more economical, to drive by electricity or steam when the exhaust from the auxiliaries passes into an open heater, allowing a loss of 10 per cent in friction and radiation, which is ample in most circumstances?

ELECTRIC AUXILIARIES:

Heat in 1 pound steam at 175 pounds absolute = ...	1,195 B. t. u.
Heat supplied main engine for auxiliaries for one hour, 1195 x 12 x 300 = ...	4,302,000 B. t. u.
Heat delivered as power by the engine, 42.42 x 60 x 300 =	763,600 B. t. u.
Heat rejected to condenser and lost from system.....	3,538,400 B. t. u.

STEAM-DRIVEN AUXILIARIES:

Heat supplied auxiliaries = 1195 x 60 x 300 = ...	21,510,000	B. t. u.
Heat delivered as power by the auxiliaries.....	763,600	
Heat rejected from auxiliaries.....	20,746,400	
Lost by friction and radiation in piping, 10 per cent.....	2,074,640	
Heat returned to feed water.....	18,671,760	B. t. u.
Heat supplied, total.....	21,510,000	B. t. u.
Heat returned to feed water.....	18,671,760	B. t. u.
Heat lost and used by auxiliaries.....	2,838,240	B. t. u.
or		
Net heat supplied auxiliaries per hour.....	2,838,240	B. t. u.

To run the auxiliaries of this plant for one hour by electricity therefore will require the work equivalent of 4,302,000 B. t. u. without making any addition for the losses in the generators, motors, and transmission, while if the steam-driven system is used these auxiliaries will be run for the same length of time with an expenditure of only 2,838,240 B. t. u.

There is also another very important consideration in connection with this question of the means of driving the auxiliaries, and that is that in general principle it is undesirable to use the finished product for a purpose for which this product partially manufactured will answer just as well. Power in the form of steam, of course, is cheaper than in the form of electricity which requires further manufacture. Besides the extra running plant cost of converting steam to electrical energy, there are the fixed charges on the whole engine room and electrical apparatus; these charges often amount to 30 per per cent of the total cost of producing current, and sometimes more in plants where the load factor is very low. In making calculations to determine whether the steam or electrically driven auxiliaries are the more suitable for a given condition, this matter of fixed charges on the engine room and electrical apparatus should always be carefully considered.

With stations whose prime movers run condensing, there are three general arrangements which may be used for heating the feed water, though, of course, there are several combinations of these arrangements used to a greater or lesser extent.

First: The auxiliary machinery may all be electrically driven and the feed water heated by an economizer, with sometimes the aid of a primary heater. If the condenser returns are being used for feed, their temperature is generally so high that a primary heater is of little or no value.

Second: The auxiliaries may be all driven by steam, and exhaust into a secondary heater of the open or closed type, this exhaust generally being sufficient to heat the feed to 200 degrees F. or slightly more. If warmer feed than this is considered advisable, the water is frequently passed from the heater to an economizer which will raise its temperature still further, to a point depending on the amount of its surface. Sometimes primary heaters are installed in the exhausts of the main engines, but with this system of auxiliaries they are seldom necessary or advisable.

Third: Part of the auxiliaries may be steam-driven and part electrically driven, and in this case almost every combination of the feed-heating devices is used.

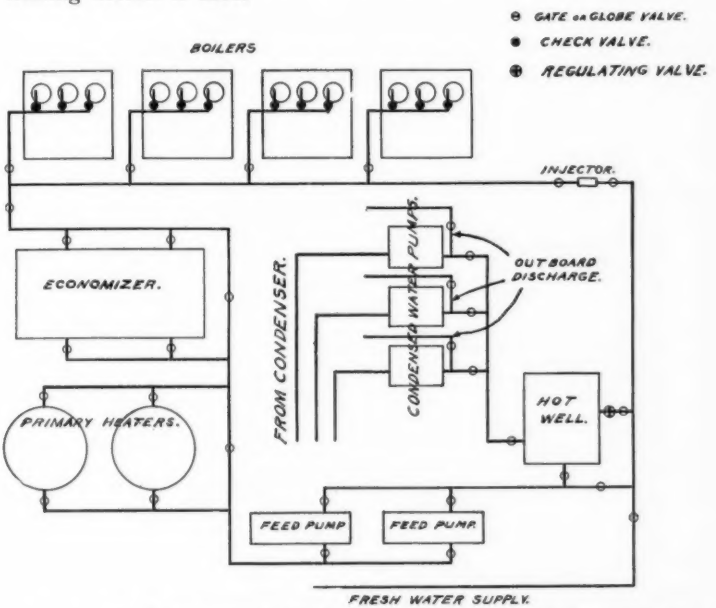


FIG. 1. FEED-WATER INSTALLATION WITH ELECTRICALLY DRIVEN AUXILIARIES.

In Figure 1 is shown the diagrammatic layout of the piping and apparatus of a plant whose auxiliary machinery is driven electrically. Primary heaters are included in this sketch merely to show how they are connected into the system when installed, but as has been previously stated, their use under the most usual circumstances is not found necessary.

Figure 2 illustrates also in diagrammatic form the layout of the

feed system for a plant whose auxiliaries are steam-driven An open heater is shown in this diagram, but if a closed heater were installed, the only difference in the layout would be that the closed heater would be placed on the discharge side of the feed pumps instead of on the suction side as shown.

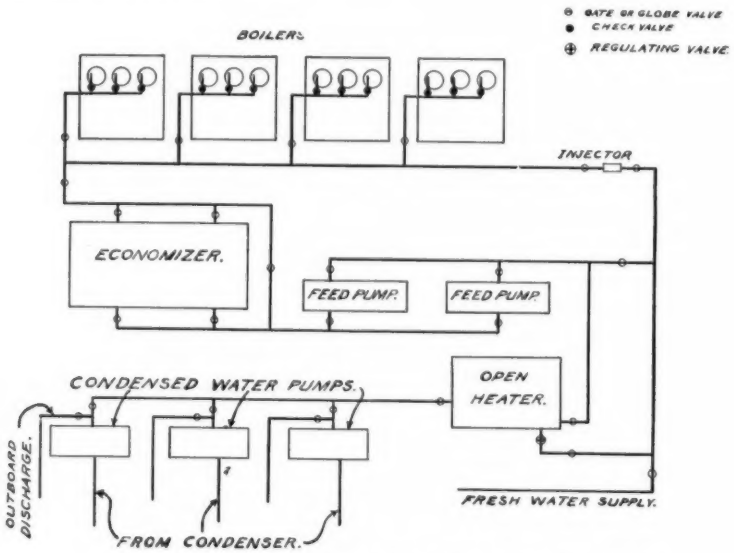


FIG. 2. FEED-WATER INSTALLATION WITH STEAM-DRIVEN AUXILIARIES.

In plants running non-condensing, the exhausts from the main engines are much more than sufficient to heat the feed water to 210 degrees F. so that no secondary heaters are necessary. These primary heaters, as they may be called in this case, may be either of the open or closed type as in a condensing plant. The motive power for the auxiliaries to give best results will generally be electric motors as there is no use for the exhaust steam. In case, however, steam-driven auxiliaries are installed, it will be found advisable, under most circumstances, to put in the most economical types as the exhaust steam from them will go to waste.

After the final layout of the system has been settled, then comes the determination of the sizes of the pumps, heaters, and piping. Open heaters are generally bought on a guarantee by the manufacturers to raise the temperature of the feed a specified number of degrees when supplied with sufficient exhaust steam at substantially

atmospheric pressure. In purchasing closed heaters, the surface required may be figured by allowing 220 B.t.u. transmitted per square foot per degree difference in temperature per hour, and specified in asking the heater manufacturers for bids; but it is better in most cases not to specify the surface as this relieves the manufacturer from responsibility as to the operation of the heater. When he is asked to give a heater which will raise a given amount of feed water a definite number of degrees in temperature when supplied with a specified amount of exhaust steam at substantially atmospheric pressure, the amount of surface required is up to the contractor or manufacturer, and he can be held to his guarantee, whereas if the surface is specified by the engineer, and the heater falls down for any reason, the manufacturer can claim that the surface as specified by the engineer is too small and he stands safe.

In deciding upon the capacity of feed pumps to be installed, the size of the units should be so chosen that if one pump, or in fairly large plants, two pumps, be laid off for repairs, the remainder will be able to supply the station at full load. The most desirable type of direct-acting pump for feeding and the one in most general use is the outside end-packed duplex type. Compound cylinders are not necessary or desirable when exhausting into a heater, as steam economy is of no object and the maintenance is necessarily greater on the compound pumps.

In the past few years, a number of the largest stations in the United States have been equipped with turbine-driven multi-stage centrifugal pumps for boiler feeding, and their use is rapidly extending to the smaller plants. The steam economy of this unit is very much less than of the direct-acting type, they produce a more steady pressure, and require practically no attention or repairs.

When it comes to the design of the piping, the critical point is in the velocity of the water in the different parts of the system. This velocity should be kept as low as is consistent with the cost of the piping, but in general should not run over 15 feet per second in the main lines, above say 6 inches in diameter, and not over 8 feet per second in the smaller pipes. It is better to run lower velocities than these when practicable, and it should be considered that the head lost in friction increases very closely with the square of the velocity. Long-radius bends will reduce the friction by a very large amount, as the resistance of a right-angle elbow to the flow is very high. It has been said that "three elbows equal a plug", and while this is somewhat exaggerated, it rather pointedly illustrates the effect of right-angle bends.

GENERAL VIEW OF N. Y. O. & W. DOCKS AT GUTTENBERG.
Showing pusher engine placing cars to be unloaded.

THE COAL INDUSTRY OF GREATER NEW YORK.

By Werner Boecklin.

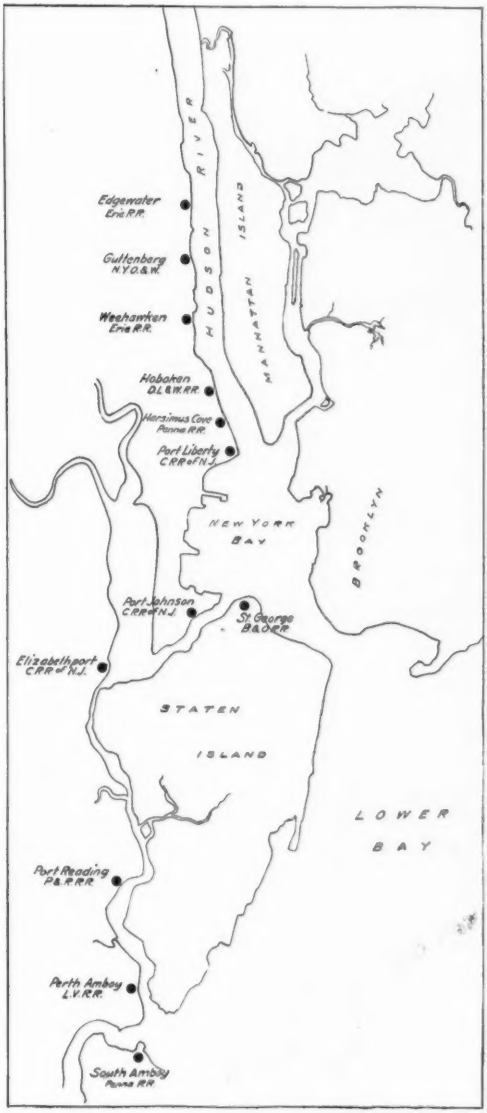
NO city in the world does a business in coal equal to that of New York, for in addition to the great numbers of consumers on land, from the giant power house down to the smallest store, there is the tremendous foreign and domestic floating equipment taking its supply from the city's coaling ports.

The thirty million tons of coal shipped annually to the New York seaboard come in greater part by rail, consigned to the various ports located within the coal-handling zone. These ports are the centers of distribution whence radiate the main supply arteries, leading either to other small centers for redistribution to large and small consumers, or to large consumers direct. Of these main centers of distribution, there are thirteen within the towing limits. Unloading docks are located at each one of them, and two have facilities for storing large quantities of unloaded coal. Only certain salient features in connection with these ports will be touched upon.

At Edgewater the Erie has two unloading docks; both are double or four track, with chutes on either side for delivery to boats and a return gravity track for the empties. The storage yard being considerably below the level of the top of docks, two incline-cable hoisting engines are employed to elevate the loaded cars. A boiler plant furnishes steam for the operation of the hoisting engines, for thawing sheds, and for general heating purposes. The difficulties which the company has had in the past on account of the freezing of the wet coal led the management to construct a series of frame sheds with just sufficient inside clearance to receive the largest cars. These are lined with tar paper and sheathed, and have a set of 4-inch steam coils placed on the floor between the rails. The plan is experimental, but it is hoped it will prove effective for the work required of it.

The Guttenberg plant of the New York, Ontario & Western consists of two piers which carry a 1,500-ton storage for a Manhattan dealer, for team deliveries, the balance of the piers being constructed with hoppers and side chutes in the usual manner. The approach grades are light, allowing the use of yard engines, thus obviating

GENERAL VIEW OF THE N. Y. O. & W. COAL TERMINAL AT CORNWALL ON THE HUDSON.

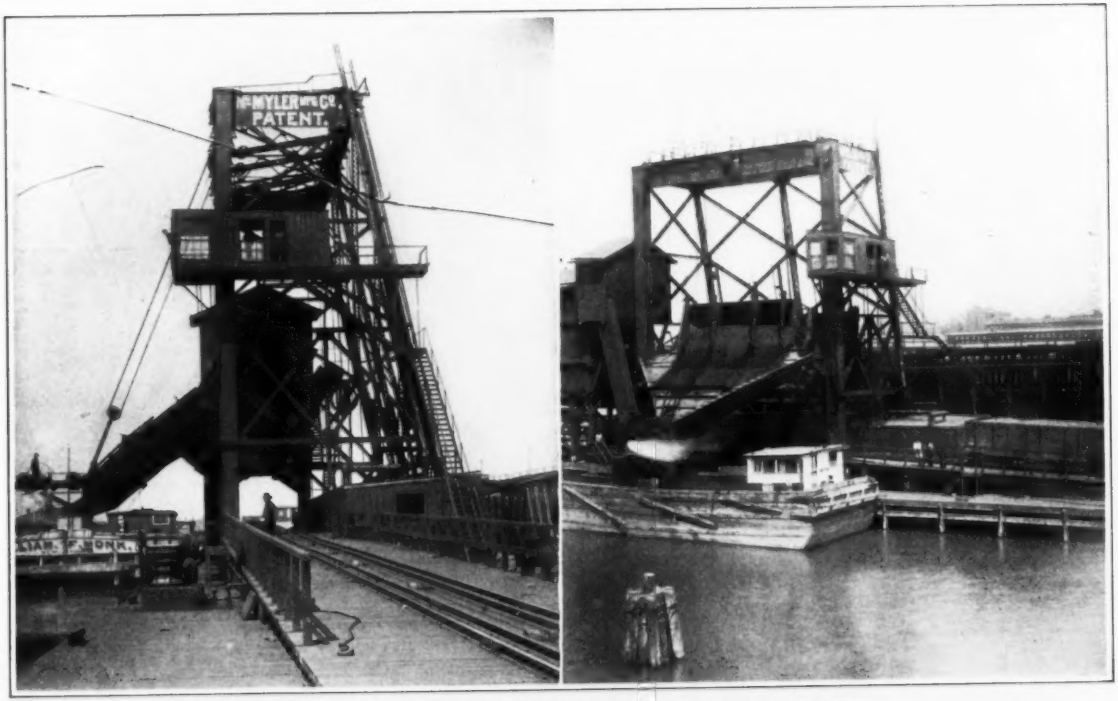


MAP SHOWING LOCATION OF COAL PORTS ABOUT NEW YORK CITY.

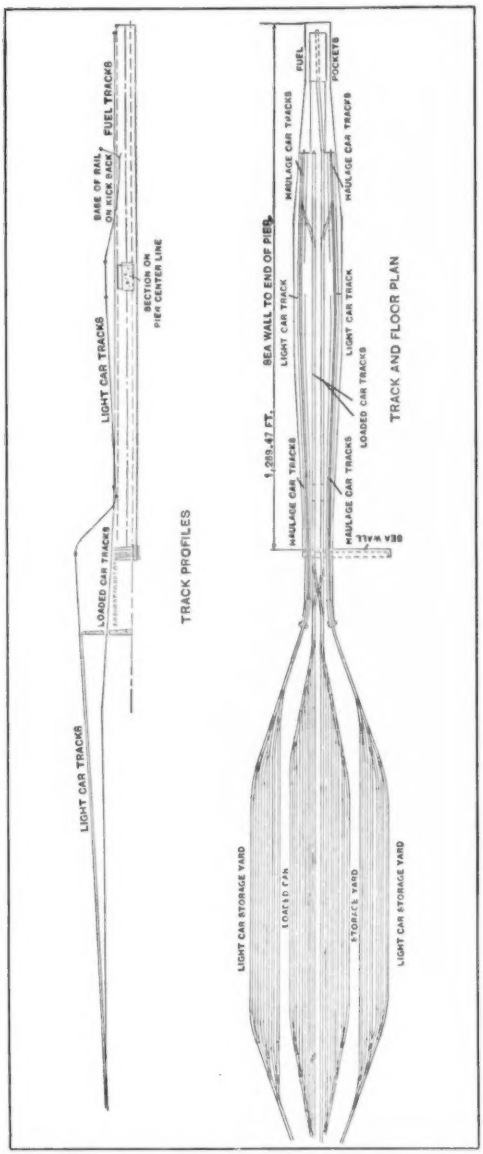
the necessity for installing hoisting machinery required in other docks of this type. There is a boiler plant for thawing purposes and for heating the office building. In 1907 these two docks with the one owned by the company at Cornwall handled 33,000 cars averaging 30 net tons each.

At the docks of the Delaware, Lackawanna & Western R. R. in Hoboken there are two McMyler dumping machines operating, and there is also one on the docks of the Baltimore & Ohio R. R. at St. George. A description of the D. L. & W. plant will prove of interest, typifying as it does an up-to-date installation managed and operated according to modern business principles. The complete plant consists of two McMyler dumps, one 1,000-foot single trestle pier, boilers

BALTIMORE & OHIO RAILROAD STORAGE YARD AT ST. GEORGE.
Bituminous coal only is handled at this point.



THE McMYLER DUMPER, HOBOKEN DOCKS, LACKAWANNA RAILWAY.

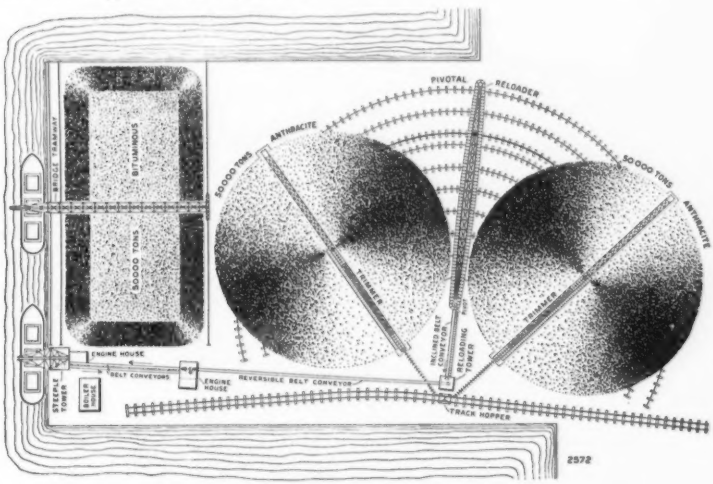


GENERAL PLAN OF TRACKS, HOBOKEN TERMINAL, D. L. & W. R. R.

of 1,800 horse power, engines and dynamo for generating current for power and lighting, fire pumps, steam piping, and auxiliary machinery. There is a complete fire-alarm system with all necessary apparatus for emergency work. One pump is in continuous operation maintaining a pressure of 100 pounds throughout the salt-water system. A pipe line carrying live steam is located in the storage yard, which is capable of holding 400 cars, with convenient connections for flexible hose and "points" for insertion into the coal in freezing weather; 125 cars can be treated overnight without shifting, and by employing two gangs 300 cars can be treated in 24 hours. A gravity yard system is used both for the tim-

ber dock and for the two dumpers. The dumpers have a maximum capacity of about 420 cars in 11 hours, and the timber unloadinig dock can take care of about 200 cars in the same time. For the operation of the complete plant about 80 men are employed, including the office force. This is a hard-coal dock, whereas the St. George dumper handles bituminous coal exclusively.

At Perth Amboy there are two docks of the usual type owned and operated by the Lehigh Valley R. R. Co. The storage plant located here is probably the oldest in New York harbor. It was erected in 1884 and since that time has been practically rebuilt. The tracks are laid out to cover about 350 bins having a total capacity of over 200,000 tons. Under the bins are nine standard-gauge tracks running in tunnels, and coal is drawn off through suitable gates of which there are three for each bin. In addition to the bin storage the tracks in yards and on wharves have a capacity of 1100 cars. The approximate annual tonnage is 2,000,000 tons.



PLAN OF COAL-STORAGE PLANT AT SHADYSIDE.

Installed by the Dodge Coal Storage Co. for the New York Edison Co. Capacity 100,000 tons anthracite, 50,000 tons run-of-mine bituminous. Unloading from boats is by 1½ or 2 ton self-filling buckets operated from steeple tower. Reloading by pivotal reloader.

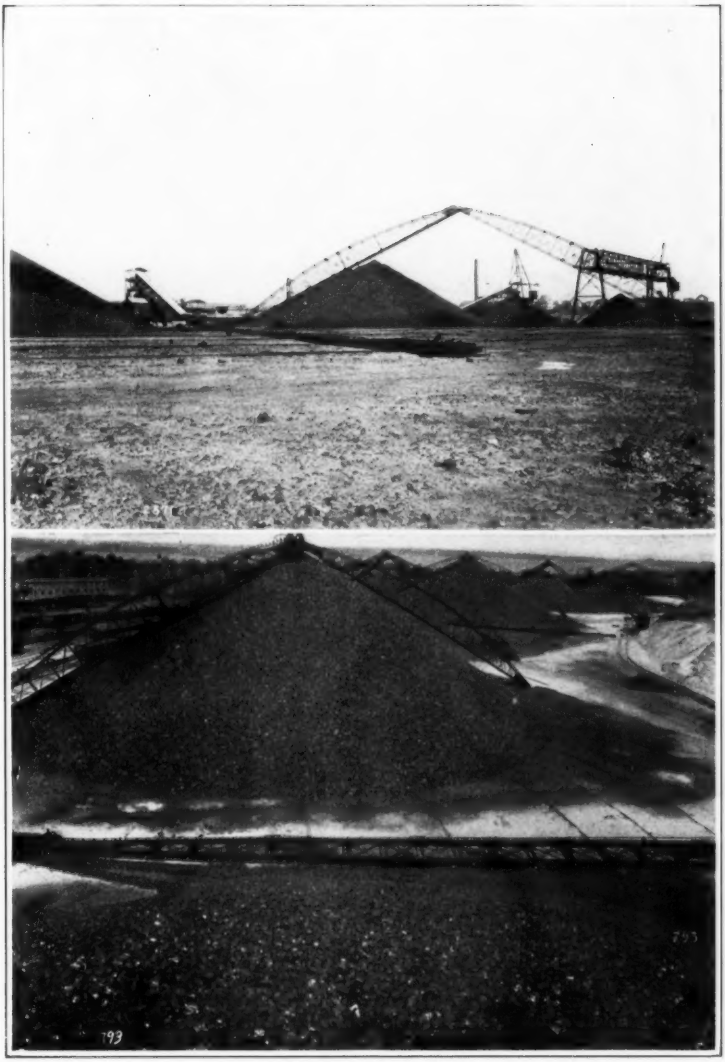
The Pennsylvania R. R. has four docks at South Amboy where both anthracite and bituminous coal are discharged into boats. Anthracite coal is stored on these docks and rehandled by wheelbarrows, but the larger amount is placed in piles by means of sixteen Dodge machines, with a total capacity of over 300,000 tons. Fully 4,000,000 tons pass through the two Amboy terminals annually.

The plant owned by the New York Edison Co. at Shady Side is, within the area under consideration, the only industrial installation comparing in size with those owned by the various railroads. This plant consists of two Dodge storage systems with a total capacity of over 100,000 tons of anthracite, and a 200-foot span bridge tramway with a capacity of 50,000 tons of bituminous coal. This storage point has connection with the New York, Susquehanna & Western R. R. and with other roads, and has full equipment for unloading from boats, thus placing the owners in a strong position as concerns their fuel supply.

The distribution of supply from the main centers to smaller centers and to consumers direct is carried on by the towing and lighterage companies, or by the railroads employing large fleets of barges, sailing craft, and tugs. Coal furnished to local consumers, and that part transferred by water from the loading ports, is towed in barges holding from 350 to 1,500 tons of coal, which are filled at the loading docks and placed alongside of the unloading dock.

Business conditions affecting the secondary centers, which are owned and operated by the dealers, have been very much modified in the past decade. The *Coal Trade Journal* has found, by a systematic canvass of the field, that since 1890, two hundred and twenty-five concerns owning yards in New York have been forced to retire from business. Increased land values and restricted dock facilities are the factors mainly responsible for the large decrease in the number of coal dealers. These factors together with increased demands of single users and sharp competition in securing trade, have brought the plants now in operation to a degree of efficiency never before realized. In Manhattan, Brooklyn and the Bronx there remain some one hundred and fifty dealers, a small number when the immense population served by them is considered. This concentration of the trade has naturally resulted in the development of a few large plants, so that it is not strange to find one company handling 1,000,000 tons annually, another over 750,000 tons, and several doing a business as high as 1,000 tons in a single day. Dealers located on the water are fortunate in that the cost of one haul is eliminated from their operating charges, and the volume of business is larger than can be handled by an inland dealer. There are less than fifty dealers having plants on the water front, these being on the Hudson, East, and Harlem Rivers and on Mott Haven Canal.

The largest single customer purchasing coal from the dealer is the municipal government. In 1905 the twenty odd departments of the city government consumed more than 350,000 tons. The addition of



COAL-STORAGE SYSTEMS, N. Y. EDISON CO. AT SHADYSIDE, AND PENNSYLVANIA R. R., SOUTH AMBOY.

The Shadyside plant, above, shows part of the anthracite storage, the hoisting tower for anthracite, and bridge tramway for bituminous coal. The Penna. plant is an extension of an older 100,000-ton storage; it consists of six 15,000 ton piles with three reloaders. All by the Dodge Coal Storage Co.

A TYPICAL COAL-UNLOADING PIER, SHOWING SIDE CHUTES FOR DELIVERING COAL TO BOATS.

the municipal ferry system between Staten Island and Manhattan, together with new school houses and other structures, brought the total to 444,000 tons in 1906 and to 511,000 tons in 1907. Most of this coal is hauled to its destination, but the Staten Island ferries, which used more than 87,853 tons last year, have convenient coaling facilities at St. George for unloading and storing. The six city departments which are the largest users are: Water Supply, Gas and Electricity, 135,000 tons; Education, 100,600 tons; Charities, 40,000 tons; Fire, 19,000 tons; Corrections, 18,000 tons; Docks and Ferries, 94,000 tons. Of the entire amount of coal purchased by the city 23 per cent is consumed in the schools. Only 11 per cent of the total is bituminous.

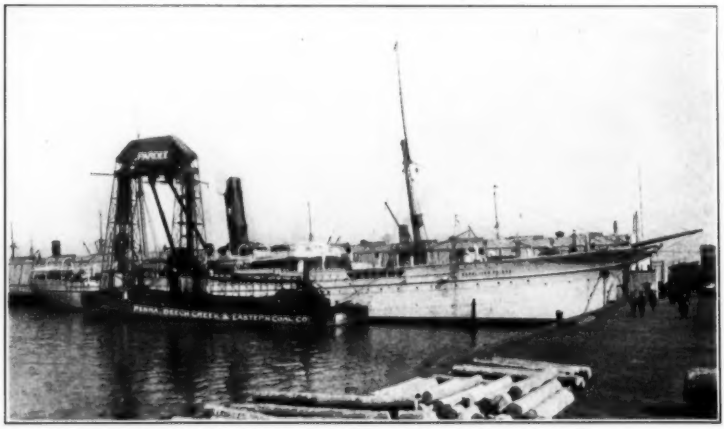
Buildings using large quantities of coal are hotels, large office buildings, high-grade apartment houses, department stores, loft buildings used for manufacturing purposes, and factories. In addition there are such buildings as colleges, hospitals and other institutions. The list gives some of the prominent buildings with the amounts of coal consumed per day.

HOTELS:—		
Waldorf-Astoria	100	tons
Hotel Astor	35	"
St. Regis	50	"
Plaza	30	"
Hotel Knickerbocker	30	"
Hotel Belmont	35	"
OFFICE BUILDINGS:—		
Singer	38	"
Park Row	26	"
Broad Exchange	26	"
Western Union	15	"
St. Paul	10	"
DEPARTMENT STORES:—		
Macy's	38	"
Siegel-Cooper	38	"
Altman's	25	"
Bloomingdale's	15	"

The larger apartment houses consume from 6 to 8 tons a day. Columbia University burns 20,000 tons annually, the new Custom House uses 6,000 tons for heating only, the main Post Office uses 12,000 tons a year for heat, light and power, St. Luke's Hospital consumes 6,500 tons for all purposes.

Another class of consumers contract directly with the coal companies for their annual supply. The New York Edison Co., with its 50,000 horse power in boiler installation; the New York Central, with a 30,000-kilowatt plant at Port Morris; the Pennsylvania Railroad, with its Long Island power station having a total capacity of 66,000 kilowatts; the Metropolitan Street Railway Co., the Interborough

Rapid Transit Co., the Brooklyn Rapid Transit Co. and the Brooklyn Edison Co., aggregating upwards of 400,00-kilowatts capactiy, all take their supply from the main centers and are all equipped for unloading at a minimum cost. The plants named consume from 6,000 to 8,000 tons of coal every day throughout the year.



AUTOMATIC BARGE COALING A PRINCE-LINE STEAMER.
Coal-handling machinery installed by John A. Mead & Co.

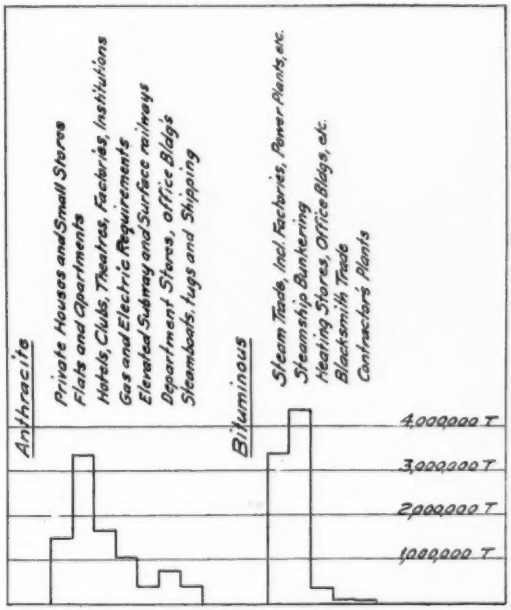
With such large power plants no question is of more vital importance than that of storage, and this has received due consideration by the management in all these cases. Take for example the Waterside Stations of the New York Edison Co. The old station has a bunker capacity of 10,000 tons; the new has a capacity of 18,000 tons of anthracite and 1,600 tons of bituminous coal, or a total for the two stations of 30,000 tons. For this type of storage the limit has about been reached, and to increase the reserve other means must be resorted to. This is accomplished by providing an auxiliary storage entirely separate from the bunker storage. Where such large interests are dependent upon continuous service, an interruption of such service becomes a real catastrophe. The coal strike of 1903 demonstrated beyond doubt the need for such a reserve; and the Edison Company, which at that time imported large shipments of coal, set about securing a location for such a storage. The result was that the Shadyside plant, already briefly described, was installed.

There is but one large power plant in Greater New York which has, in addition to its bunker storage, an auxiliary storage adjacent to the plant and with necessary equipment for rehandling. This is the Central Station of the Brooklyn Rapid Transit Co. where 100,000

tons may be stored and where coal can be taken out of storage and delivered to bunkers at a minimum cost.

The United States Government took 38,000 tons through the Brooklyn Navy Yard dock in 1907. This dock has a storage capacity of 10,000 tons and every precaution is taken for the prevention of fires, since only bituminous coal is handled at this point.

Another large user in this class is the Consolidated Gas Co. This company has nine plants in Manhattan, the Bronx, and at Astoria. These plants hold in storage 80,000 to 100,000 tons coal the year round, or about a 90-days supply, and consume 800,000 tons of anthracite and bituminous coal.



TONNAGE, NEW YORK CITY COAL TRADE.

From statistical data published in *The Coal Trade* for 1908 is prepared the diagram showing tonnage used in city trade in the year 1907. The shipments at New York harbor points in 1907 amounted to 28,444,000 tons, of which 16,753,000 were anthracite and 11,691,000 bituminous. Of the total shipment 50 per cent is consumed locally, not counting the 4,391,767 tons placed in steamer bunkers.

But a small percentage of this enormous bunker tonnage is handled automatically. Some 20,000 tons per month of bituminous coal are transferred to ships by two automatic machines owned by a leading coal company. These machines, comprising a barge holding 1,000 tons of coal and a gravity bucket conveyor elevating the coal to sufficient height to discharge into the ship's bunkers, have been in operation for a number of years. The efficiency of this method is controlled only by the ship's facilities for rapidly stowing the coal.

A SUPERINTENDENT'S VIEWS OF AMERICAN SHOP AND LABOR CONDITIONS.

By John Geo. Niederer.

In the following pages, Mr. Niederer gives his views of the discussion begun by a New England Machinist in our April issue, and continued by Mr. C. R. McGahey in June. His estimate of conditions will be read with interest on account of his evident optimism and strong belief in steady improvement.—THE EDITORS.

AN experience of thirty-nine years at bench and lathe has made an impression upon me widely different from that received either by Mr. McGahey, or by the New England Machinist, whose views were recently expressed in this Magazine.

I was sent out to begin my fight for a place in old New York as a graduate of Grammar School No. 13, at thirteen years of age. On account of my German extraction I had to fight every boy of my years in the first shop I entered (a printing establishment) and life, indeed, has been a fight ever since to obtain bread, clothing and comfort for my family. It has been a gradual working up from lathe and bench to inspector, foreman, assistant superintendent, general works superintendent—a rise from $3 a week to $8,000 a year; but at this moment, though out of a job and out of money, I want to profess unwavering belief that the United States and its sons have a future greater and grander than any past, and that at this day to those who are willing to take hold opportunities are offered such as we in our earlier days I am sure never had.

The New England Machinist speaks of apprentices in the iron trade receiving 65 and 85 cents per day, and then being taught nothing. I had a like experience in New York at fourteen years of age—but I did not stay; I got another job, where I was treated more fairly. I know boys today—many of them—who work all day and go to school at night to study mechanical drawing. I have known apprentices to do this ever since I have been connected in any way with manufacturing concerns. You can lay a heavy wager that if boys really have the ambition in them they are going to win. You can't take the ambition out of a boy of this kind; if he does not get fair treatment at the machinist's trade he will turn to dentistry or some other better field, for he is bound to win and to make the coin to raise another American family.

It is my conviction that apprentices nowadays serve their full time just about as they did when I was young; a great many did not do so then. My experience as superintendent covers a period of twenty-five years. As I recall it, the boys of American birth whom I have had as apprentices either served their full time or went elsewhere because they received higher salary and better opportunities to learn; as I remember, also, they have been as worthy and industrious as boys of any other nationality that I have employed, and far more ambitious. A great many naturally find that the factory is not the best field for a bright man who desires independence and fortune.

In all the years of my factory management I never had any trouble with unions. We had our differences, the walking delegate and I, but with a little "you tickle me and I will tickle you" we would part the best of friends. Judging from what I have been told by men who had been taught under the old system, (I heard this from journeymen with whom I worked when I was an apprentice) the manufacturer in the old days was a positive slave-driver. The effort of the bosses then was to get the boys to live with them, and it is a generally accepted fact that the treatment received by the boy apprentice was as a rule not the kindliest, but far removed from it. Of course there were exceptions, as there were in the days of slavery.

No; there was no talk of unions then, further than that one would occasionally hear that a union was to be started; but this was because the world generally, and the States in particular, had not yet made the progress in the social evolution which is gradually proceeding, and in which the American boy is going to be a great factor. I do not belong, and I never have belonged, to any union. Labor and capital will go hand-and-hand when the millennium is established. The workman in the average is not intelligent, but he is becoming more and more so. I believe the workman thinks he is the only tax payer—but so does the boss. If the New England Machinist can really convince the corporations that they have inflated values, he should be equally able to convince the average workman that his estimate of himself is far in excess of his actual worth.

The New England Machinist ought to be thankful to think that his boys desired to be draftsmen, engineers, and dentists rather than simple machinists, leaving this work for the sons of the foreigners who are now taking their places in the shops—these coming sons of foreigners who will some day be proud American mechanics.

It seems to me it was a mistake for the boy not to take the position offered him at $1.40 per day, for this appears to have been his opportunity to show the people what was in him; very possibly before

a year had passed his salary would have reached a much higher figure. I think, however, all will agree that he is better off as a dentist, for no doubt he will soon be able to start his own business, while as a machinist he might never have done so.

The manufacturers do, indeed, employ the best legal talent, but not always, and some of the lawyers in the service of the unions are just as able. The New England Machinist says: "The laborer is sure of nothing;" he never was, outside of his industry. Again he says, "the mechanic can not water his stock." Well, I have engaged many a one who had watered his stock to such an extent that the excessive valuation was many times greater than his actual worth.

Now for Mr. McGahey and the spoiled boy. I must honestly say that throughout New York, New Jersey, and Pennsylvania I see no difference at all. In fact I think the boys are brighter, and it seems to me that we boys in our time gave our bosses more trouble than ever the boys gave me. In my many years' experience as factory executive I have had no trouble with my boys as regards union cards, and I am sure that many large concerns, like Baldwins of Philadelphia for instance, have no such trouble with their host of youngsters. I know when I was an apprentice at Tiffany's I hustled out a lot of work and one of the men objected saying: "There are others who want some work;" so this is an old failing and did not find life first in unionism. I have noticed no change in the conduct of the young people and they seem to me as well behaved today as they ever were in my youth. Every young man who shows ability receives recognition—if not in one shop then in another; the young people know this and why should they not move? I do not believe it would benefit any one if we asked all men to carry certificates as to where they worked previously. This is additional red tape, heavy to bear and of no good. When I want men I advertise and then pick out those I think will suit. I don't care whether they are union men or not; if they are capable and industrious they remain— if not, they go out.

Our scarcity of American mechanics, in my opinion, is due only to the fact that the American youngster of the second generation desires to go higher up. He does not want to be a machinist, humble and passive, keeping his head bowed down over his bench from 7 o'clock in the morning until 6 o'clock at night. Can you blame him?

I have found that most American apprentices are from the country. City boys are full of ambition for other things than factory life, and I think their efforts as a rule are crowned by their success in becoming engaged in pursuits which offer greater independence and larger earning capacity.

EFFICIENCY AS A BASIS FOR OPERATION AND WAGES.

By Harrington Emerson.

III. THE STRENGTH AND WEAKNESS OF EXISTING SYSTEMS OF ORGANIZATION.

The two instalments of Mr. Emerson's series already published, in our issues for July and August, dealt with, respectively, typical inefficiencies and their significance, and the tendencies and influence of national efficiencies. In the part now presented he illustrates strikingly the differences between line and staff systems of organization, the limitations of each and the possibility of effective combination of the two, and applies the principles dominating the most efficient organizations, natural or artificial, from which he draws his illustrations, to the practical problems connected with the operation of an industrial concern. Next month Mr. Emerson will discuss the averages attained in standard practice, and in November, the methods of establishing standards for the introduction of the efficiency system as a basis for operation and wages.—THE EDITORS.

IT is notorious that great aggregations of wealth and power usually do not operate as efficiently as smaller concerns. The various operations of a railroad or of a manufacturing concern are performed far less economically and efficiently than similar operations in smaller and more compact industrial organizations. Also nothing is so gigantically inefficient in view of its power and opportunities as such an organization as the United States Government. In what it does, it cannot compare relatively with the comfort, security and hygienic conditions supplied by a large, modern American office building.

The ten-million-dollar and upwards company ought to be able to supplement every dollar-a-day worker with a $200,000 a year staff of assistants, thereby making the worker four times as effective and gaining a crushing advantage over the smaller concern which cannot afford the same aggregation of specialized knowledge. The great concerns, however, have conspicuously failed to develop this advantage even if they do have a large staff of experts, a very different thing from a staff organization which gives the least worker the needed direction, stimulus and advice. A $200,000 staff for a dollar-a-day man is neither utopian nor expensive. On the contrary it is to the highest degree economical, if almost infinitesimal attention from a very high priced man will make, as to his specialty, one thousand or twenty thousand low-priced men four times as effective.

To preserve the adult individual, Nature uses staff organization; to preserve the race, nature uses line organization. Both are necessary and they may operate separately, they may alternate, they may work in parallel; but always and everywhere it is one or the other or a blending of both. Man, the individual, is fitted out with a number of aids, each far superior to him, each knowing what to do and how to do it, knowing how to respond to his every call to the extent of its ability. His lungs, his heart, his stomach, his nervous system, how instantaneously they come to his rescue in an emergency! On the other hand a father is succeeded in time by his son, one generation gives way to another, "the king is dead, long live the king!" This is line organization.

The strength of line organization lies in its indestructibility. A company cannot be destroyed as long as two men are left. The captain is succeeded by the lieutenant, and if this one falls, a petty officer takes command. There is always some one in authority. The weakness of line organization is that no one man knows much more than any other, that promotion is by seniority and not by merit. If a company loses its way in the woods it is all lost together. The captain has no special knowledge to meet the emergency. The weakness of staff organization is that if one member of the staff collapses, the whole organization goes to pieces, as when the heart stops beating or the lungs fail to find air. The strength of staff organization lies in its ability to multiply many fold the effectiveness of other staff members, all co-operating to make possible such a wonderful thing as a man, a humming bird, a midge or a yellow-fever microbe.

Organization may be conscious or unconscious. The authority in charge, whether individual or intangible, whether one or many, may know how to do the work or may not know how to do it. In the first case performance may be delegated to subordinates; in the second case it must be, if the work is to be well done, the actual worker, as far as the work is concerned, being a subordinated superior. The most perfectly organized entity in the universe is the living thing. There is an unconscious, unseen authority over it, not in the theological sense, but in the instincts with which it is endowed.

Passing from the single body to a community or family, we find similar organization, a central authority supported and supplemented by special staffs. Isms fail—individualism, communism, socialism, despotism—not because there is not serviceable value in each, but because form of organization counts for more than theoretical ism, and the highest organization relies on and utilizes all. Institutions

have evolved from the primitive family and tribal life of birds and mammals, and birds and mammals, notably man, have evolved, molded by forms of organization.

There is always line and staff in organic nature. Line organization developed in its specially human form not in the family or tribe, but when men gathered in bands, generally for mischief or damage either to animals or to others of their own kind. The experienced hunter led a band on a hunting expedition or the fisher led a company to fish. As the hunters developed into maurauders, as the fishermen developed into buccaneers there was pure line organization and very little, if any, staff. The hunter and war captain had himself been hunter and warrior, the captain of the boat had been fisher and fighter. Because he was older and stronger or more experienced he commanded other men, none of whom knew more than he did. When the medicine man or priest accepted a disciple there was even less chance for staff, since the adept knew far more than the neophyte. Thus all through the development of army, or navy, or church, we find line organization, whose unit is the company, headed by a captain. This kind of organization is at the opposite extreme from pure staff organization found in the living body, and it is also distinct from the mixed line and staff found in primitive family life. The shops and schools adopted line organization almost without modification. There was indeed subdivision of labor, since all foremen did not direct similar activities nor all teachers teach the same branches, but these differentiations were not into staff functions.

Some modern organizations of tremendous strength are those in which staff alternates with line, as in a base-ball team. The ins play in line organization, all subject to the captain, each passing through exactly the same round, since a part of the play, as to its entirety, is handled by each. The outs, also subject to the captain, play distinctly in staff organization, the pitcher, singly, doing all the pitching against each of the ins, the catcher, singly, doing all the catching against each of the ins. The whole inning is played by each. It is because the staff specialists, the pitcher, the catcher, etc., are superior to the average skill of the ins and combine against each one separately that in the best games there is no score.

In all organizations line and staff have their place. Organization has always been a means to an end, and it has therefore always been an evolution rather than a creation, generally lagging behind requirements. Long after the time when staff should have come to the rescue of line, line traditions and line prejudices have continued to

prevail, each line officer trying to create a staff of his own. In the navy a strong staff has by a process of compulsion been added to the line. Supreme as he was, no sea captain quite dared to claim that he knew all about furnaces and boilers, engines and propellers, refrigerating and illuminating accessories, so there have been developed in marine organization very strong staffs. There was not the same compulsion in the army. It is von Moltke's greatest claim to fame that he perceived the deficiency of line organization in the army and supplemented it with the general staff which made the Prussian army the marvelously supreme organization it became shortly after 1860. The theory of a general staff is that each topic that may be of use to an army shall be studied to perfection by a separate specialist and that the combined wisdom of these specialists shall emanate from a supreme staff. The specialist knows more about his one subject than all the rest of the army put together, but the whole army is to profit by his knowledge. One man may be the authority on military maps, another on balloons, another on roads and road making, another on sanitation, another on explosives or rapid-fire guns, an ever widening list Nothing is to be left to chance, or to individual ignorance or brilliancy. The North Germans were not more courageous, not better individual fighters than the South Germans, the Austrians, the Hungarians or the French. Napoleon in 1806 had had no difficulty in defeating the military organization of Prussia, inherited from Frederick the Great, and it took nearly ten years of European coalition, all of Russia, all of Austria, all of Germany, all of Great Britain, to overthrow the French. The Prussian army in the decade 1860-70 became what it was, not on account of men or arms, but through the supreme genius of one man whose creation, the general staff, used the line organization as one of the means or implements to the all-important end. If a man has special military aptitudes, special genius, the staff is the place for its opportunity and development. In the line special genius only makes trouble. Grant deprived General Butler of his command because Butler did not know how to obey. Nominally, under von Moltke's plan, the line remained supreme, the highest command being vested in the King of Prussia, though he was merely the spokesman for staff plans, even as in England the monarchical line is supreme with its personal staff of earl marshals, etc., yet all the real power lies with the cabinet, a staff organization. It was owing to staff knowledge and staff plans that in 1866, the Prussian army, two weeks after the outbreak of hostilities, overthrew the combined armies of Austria and of South

Germany. It was owing to staff organization that the united German army of 1870 decided the war against France, declared July 14, at Sedan on September 2. The French plans for mobilization required 19 days but von Moltke's plan for German mobilization required 18 days, and it was strictly carried out in neither more nor less days than the 18. The French mobilization took 21 days and this delay placed the seat of war in France instead of along the frontier or in Germany. French officers were not even provided with maps of French territory. The French plan of campaign failed before it was even tried, because of the fatal three-days' delay. On August 6, only 23 days after the outbreak of hostilities, one of the bloodiest battles of the war occurred.

Napoleon I was a marvelous genius, but, working through line organization against line organization, he had to get rid of all his rivals, make himself ruler, dictator, emperor, before he could carry out his plans. Von Moltke left the line undisturbed, gathered his eminent military contemporaries into the general staff with him, and through the staff gave his king, the head of the line, an organization before which all the military power of Europe crumbled. It was King William's great merit that he had the good sense to listen to the staff advice of such specialists as von Moltke for war, Bismarck for diplomacy. The Japanese, seeking the best there was in western organization, adopted and perfected in their army the Prussian staff system. At the relief of Pekin they proved themselves in all staff matters superior to any of the allies, the Germans included. Their maps, their Red Cross, their commissariat, their discipline, their humanity were all better. Before and during the war with Russia it was Japanese staff knowledge and staff skill even more than the high ideals and bravery of the individual soldiers and sailors that brought about the final victory.

Yet even von Moltke's marvelous combination of old line and modern staff could not be adapted without change to railroad or manufacturing activities. Its deficiency lies in the fact that the members of the line, who are many, are excluded from intimate relations with the staff, which is numerically so weak. When the line is supreme there is a great deficiency of special knowledge. When the staff is supreme there is a great deficiency of personal fructifying experience. In last analysis the man in the line, the man down at the bottom of the line, meets the difficulties, and he is the one who most needs staff assistance for his special case. He is the one who should be able to call on the very highest special talent to solve his $0.10

difficulty. He finds this assistance outside of his daily work far more than within its limits. If, for instance, in New York city he wishes to transport himself from the north end of the city to the south end, he offers a five-cent piece and finds at his disposal a fifty-million-dollar subway. In his daily work, however, there is no assistance. For his bread and butter task, which alone makes him of value to others, there is no assistance of this kind.

What is needed in organization is complete parallelism between line and staff, so that every member of the line can at any time have the benefit of staff knowledge and staff assistance. This kind of organization does not exist in perfected form to-day. Modern organizations are defective because they individualize instead of generalize their staffs. The president of a railroad or of a manufacturing plant apportions duties among several vice-presidents, each one of whom takes up a line of duties. This is necessary, but in the old days in the palace of Pharaoh it is not stated that the chief butler organized a staff with a head baker or that the chief baker organized a staff with a head butler. Each vice-president of course requires a staff of his own for his special line of duties, but there are general needs which are the very fundamentals of strong organization and these needs should be under general staff officers, all of whose aggregated wisdom should be available to guide, not only the president and the vice-presidents, but also each subordinate official down to the lowest man in the line. Because there is no general staff of this kind each official down to the worker attempts, more or less awkwardly, to create his own general, as well as his particular, staff. There is specialization of line activity, which is always advantageous, but there is also multiplicity of different kinds of general control, which is wholly bad. Imagine an army to which each soldier came with his own individual rifle and ammunition and kit, in which each captain had his own system of tactics, in which each general had his own special plan of campaign! Yet this is virtually the condition of railroad and manufacturing-plant organization to-day. Much of the time and energy of each official is taken up with keeping in order and adjusting to the whole his unregulated staff activities and eccentricities. One of the defects of this kind of organization is that the staffs of the different officials are not correlated. It makes no difference whether the head of a company is an individual or a commission, the organization is that of the line, the old military line, which at best has progressed as far as monarchy with a monarch's staff.

With full understanding of the strength of line organization, of staff organization, and of their mutual advantage to each

other, and with a general comprehension of what both have accomplished in the past, it becomes possible to devise and outline a modern line and staff organization suited to the largest industrial concerns. The task would be hopeless if it were necessary to displace or even to modify existing line organization, since scarcely anything is as tenacious of life as institutions. But happily this is not necessary. Von Moltke added staff to line without a jar. A perfect staff could be added to modern line and be self-supporting from its inception without a jar.

A modern company, whether railroad or industrial, is organized for a specific purpose which is secured by an interplay of men, machines, materials and methods. The specific purpose is the end in view, but the interplay is the all important means. Whatever the vice-president's department, he has men, equipment, supplies and conditions to deal with. Whatever the manager's duties, he also has men equipment, materials and conditions to adjust to one another. Whatever the superintendent's duties he also is confronted with the same general problems as to men, machines or locomotives, materials and methods. The foreman meets the same problems of men, materials, machines and methods, and even the individual worker has also his problems of man, of machine, of materials and of methods. It is evident that the most philosophic way to meet general and universal problems is by general and universal solution. That is the solution offered by Nature. We have hands, feet, a head and various other bodily parts, each doing various work, but there is only one heart, one set of lungs, one stomach, one telephone system, each doing specific work. The general problems, therefore, appertaining to men, to materials, to machines or equipment and to methods or conditions, can be initially divided into four groups. All four groups, which more or less interweave, should come under one chief of staff. Under him should be various heads of staff. The subdivisions of the staff depend on the particular business, but a general scheme, modified to meet special conditions, would be that of the four groups mentioned.

AS TO MEN.

1.—A head of staff to plan, direct and advise as to everything appertaining to the well-being of the employees. This is in itself a very extensive and important department of staff activity. Men should not be able to connect themselves with a company except after examination as to their moral, physical and professional fitness. Everybody knows that one quality of steel will cut four or five times faster than some other quality, and a modern tool is selected not because it has the shape of a drill but because it is of a composition

that can be made into a good drill or into any other good tool. Men are still selected not on account of qualities that would make them good in any particular direction, but because at the moment they call themselves this or that. Having entered the service of a company with difficulty, it ought to be a catastrophe for a man to leave it, because, while with it, so much appertaining to his physical, financial and professional welfare was provided, so much he could not by any possibility provide for himself.

The line organization of a staff head in charge of welfare would extend down to where it was available with its advice and help to the humblest worker. There is no reason, for instance, why a watchman, whose business it is to look for bad conditions, should not combine the duties of a watchman with those of welfare work and advice. He would meet special cases that would otherwise escape observation and report, and carry them up to his staff superiors, but he would also have been instructed by his staff superiors and given standards by them as to all usual conditions, so that he would have at his fingers' ends standards for the use of the workers, standards evolved by specialists of the highest rank.

AS TO EQUIPMENT.

2.—A head of staff to plan, direct and advise as to everything appertaining to the adjustment of structures, machines, tools and other equipment to the work in hand. There is very little difference between good handling of equipment and good handling of men. The rules that apply to the one case will generally apply to the other. Much has been learned about the proper care of men from methods evolved for the care of equipment, and much has to be learned about the care of equipment from methods evolved for the guidance of men. It is not to be forgotten that in the human organism the whole is incapacitated by a seemingly slight injury to a single part. No man will work efficiently with a cinder in his eye, or a splinter under his nail. Neither will a plant work efficiently if little things go wrong. Single items of equipment are often of very great perfection, whether a Corliss engine or a twist drill, but from twist drill to general design and equipment of plant everything is usually wholly out of relation and balance. Recently, in consequence of staff organization, it was found necessary to relocate over three-quarters of all the machines in two large and fairly modern plants. Each machine had been doing good work by itself and no one looked further, but the moment its relation to other machines or to the progress of the work was investigated, the conditions at once appeared impossible and unbearable. It is expected that this relocation of machines, together with other staff

reforms, will result in an increase of output of 40 per cent. without additional men or equipment. The high officials of every railroad point out the glaring defects of early location or equipment—the fact, for instance, that out of 600 locomotives there were 550 different types, instead of 6. The earlier builders had no staff advice.

This staff line in charge of the use of equipment also extends down until it is within reach of the worker. An example will show both the nature and the effects of staff organization. A staff was organized on a transcontinental railroad to advise generally as to the care and operation of shop machinery and tools. The duties of the staff, which extended from the vice-president's office downwards, were:

a. To secure suitable machines and equipment;

b. To give them the best possible care; and

c. To give the workers advice and directions as to how to use the equipment most efficiently.

The expense of maintaining shop machinery and tools, on this railroad for the year 1903-4 was $487,171; the unit cost in relation to output was $10.31. On a competing and largely parallel railroad, working under similar conditions, the cost in the same year was $487,150, and the unit cost, $9.55. As a result of staff activity and control on the first road, by the year 1906-7 total costs had fallen to $315,844, and unit costs to $4.89, but on the other road, where line organization was not supplemented by staff organization, the total costs rose to $638,193, unit costs remaining virtually constant at $9.81. This saving in expenses of $322,000 was brought about by a staff costing less than $10,000 and the $10,000 is included in the $315,844.

One subdivision of this maintenance problem was the care of belting. This had cost (for maintenance and renewals) at one of the main shops about $12,000 a year, and it was so poorly installed and supervised that there was an average of twelve breakdowns every working day, each involving more or less disorganization of the plant in its parts or as a whole. With the authority of the vice-president and in conjunction with the general purchasing agent, the whole subject of belting was taken up. A few general rules were laid down:

a. That the quality of the belts should be the best obtainable;

b. That the installation and care of belting should be put under the care of one competent man; and

c. That he should so maintain belts as to prevent breakdowns. The worker in actual charge of belts, a promoted day laborer, was given standards, took his directions from a special staff foreman, only one of whose duties was knowledge as to belts. The foreman had

received his knowledge and ideals from the general chief of staff, who had made belts a special study, and this general chief of staff was in the first place inspired and directed by a man who had made a nine-years' special study of belts and who was the greatest authority in the world on the subject. The belt foreman had as much of this knowledge at his call as he desired to absorb, but he in turn was in immediate contact with each individual belt, with the machine it was on and with the worker using the machine. The chief of staff learned as much from the belt foreman as the belt foreman learned from the chief of staff. The cost of maintaining belts fell from $1,000 a month to $300 a month, the number of breakdowns declined from twelve each working day to an average of two a day, not one of them serious, and even the few breakdowns were due almost wholly to defective installations, such as narrow pulleys, which it was impossible to remedy without unjustifiable expense.

As to Materials.

3.—A head of staff as to materials, their purchase, custody, issue and handling. Subsidiary materials are only too often purchased on the basis of price per pound rather than on basis of cost per unit. This is inevitable, since no one is able to give the purchasing agent any standard as to cost per unit. After materials are purchased they are frequently given such poor custody that they deteriorate or disappear before being used. They are still more often issued for extravagant and wasteful use. The economical handling of materials is a special art. In a large steel plant, staff control of handling material reduced the cost of handling per ton from $0.072 to $0.033, and increased the number of tons handled per man per day from 16 to 57. Here again was the same kind of staff organization, calling down from the top all the most valuable knowledge in the world as to this one subject, working up from the bottom from actual daily contact with changing conditions.

As to Methods and Conditions.

4.—A staff head as to conditions and methods, including standards, records and accounting. It has been found practically impossible either to maintain standards or records unless they are tied into the accounting. This is because there are standards as to money entries and none as to times or performances. This does not imply that records or standards shall be an outgrowth of accounting. Either is quite as important as accounting, and if a choice had to be made between good accounting coupled with bad practice and good practice coupled with bad accounting, most practical men would choose good practice. It is because at the present time good account-

ing is unrelated to good practice that extensive accounting is viewed with such extreme disfavor by the practical man. Standards are wholly distinct from accounting, records are wholly distinct from accounting, but all three gain greatly when tied in together. It is virtually impossible to maintain records unless there are standards of performance, but these can never be evolved from either records or accounting. The determination and establishment of standards is a peculiar art, yet one of fundamental importance, for, without a sea level from which to start there is no measuring of mountains or of absolute heights. Railroads and industrial plants have systems of accounting based on the same general plan, but their records are not similar, so that it is difficult, if not impossible, to compare performances on one railroad with those on another railroad. There are certain records at the top, there is occasionally a certain semblance of a record at the bottom, but between the bottom record, on which, after all, everything rests, and the top record which is supposed to reveal the condition of the company, everything is vague and disconnected. It is astonishing, almost pathetic, that presidents' reports and Wall Street publications solemnly print costs per locomotive mile or cost of fuel per 1,000 ton miles when the initial records out of which the final reports are built up are wholly unreliable.

With a staff specialist on records, with record specialists under him reaching down into intimate, hourly and departmental touch with the worker, every gang boss, every worker could confide to him his desires and his needs. A good record may increase the output of a machinist quite as effectively as a good belt or tool, as good material, and when the worker needs help of this kind he should have it at hand. The writer knew a worker on time allowance for every job. The company was satisfied with 100 per cent. efficiency, but this particular worker had set himself a standard of 120 per cent., his earnings depending on his monthly efficiency. To attain this he could not afford to lose track as to any single day; he had to know, in fact, how he stood as to every job during the day. He therefore needed a record of both his standard and actual time. An ambition of this kind is of extreme value to the company, not only because it decreases the cost and increases the output and reliability of the man, but because of its effect on all the other workers. This man made out his own records, on awkward and unsuitable blanks, and they were kept in such a way as not to fit in with or be of any value to the general scheme. Here was a case where the desire of the worker could well have been assisted by the skill of the specialist, each learning much from the other and together evolving a form of record of universal,

optional use. Had any question come up beyond the skill or the authority of the local record man, he could have taken it up with his superiors until it had met and been solved by the grade of talent required.

Standards of performance are not less of a general character than records. In railroad operation the only work which is accomplished in a definite predetermined time is the running of the passenger trains. The Pennsylvania Railroad, for instance, reports that it ran its 18-hour train from New York to Chicago 312 days out of 366 exactly on time, an arrival efficiency of 85.24 per cent. In April the Chicago train arrived in New York 28 days out of 30, or 93.33 per cent. on time, being on one of the two days only 1 minute late. Probably this train runs with a time accuracy of 99.9 per cent. if one should add up all the standard time minutes in the year and divide by the actual time taken. Perhaps the Pennsylvania Railroad keeps similar efficiency check on other passenger trains, but how about all its other items of expense incurred for either material or time? Do they also show 99 per cent. efficiency or would they show about 60 per cent. efficiency? If standards were established, if records were kept, it would be possible soon to attain almost automatically the same high efficiency as is now shown in the 18-hour train. It has cost money, a great deal of money, to run the 18-hour train as efficiently as it runs. It would save money, a great deal of money, to run other operations on a 100 per cent. schedule.

Both accounting and records are very greatly simplified when connected up with standards. When the housewife buys a pound of tea or of meat she hands over the money and she receives in return a definite and agreed-upon equivalent in weight. This is exactly what the railroad company or the manufacturing concern does not do when it pays for services. The company does not even know what it ought to receive as service in return for the money paid, and so it accepts, not what it ought to receive, but what the payee gives, generally much less than it is entitled to.

The result of perfected staff organization is that everything is well and quickly done when and where wanted, that all costs are predetermined, that the responsibility for any deviation is immediately located, that the heads of both line and staff can direct far better than they are now able to, that costs of performance decrease, and that output from the same equipment and men increases. The staff is to the line what the good road is to the automobile. Without it neither speed nor smooth running nor economy is attainable.

EDITORIAL COMMENT

Who Pays the Freight?

IN a plausible little "Freight Rate Primer" circulated in support of the railways' argument for a 10 per-cent increase of rates, the effect of such advance is made to appear insignificant, so far as the shipper or the consignee may be concerned, by the method of assuming figures for a single unit of product. In the case of a $50 dining-room suite shipped from Grand Rapids to Chicago, for instance, the additional cost imposed by the higher rate appears to be 16 cents. On a reaper shipped from Chicago to a point 100 miles west of the Mississippi, it is stated, it would be 17½ cents. The thinly disguised fallacy of this demonstration, apart from the special distances and conditions assumed, is that it regards but one of the very great number of movements of material which must take place between the ore in the ground and the timber on the stump, and the delivery of the finished work to the user. Every pound of steel, every foot of lumber, every gallon of paint, every nail and bolt, every machine on which the materials are worked, every ton of coal burned in mills and factories, will have paid their tribute—some of them again and again, as they are moved from place to place in various stages of manufacture—before the furniture or the agricultural machinery can be placed on the cars at the assumed points of origin. This part of the influence of increased freight rates, far the largest part, and one which would be expressed in an increase of price at the point of shipment, the Primer overlooks. And we cannot finish the argument more forcibly than by quoting the very words of the eloquent plea for the railroads advanced by William C. Brown, senior vice-president of the New York Central:

"The whole fabric of freight rates, from the first shipment of raw material, is simply a transfer or carrying forward of freight charges, until it reaches the final purchaser or consumer, *and he pays the freight.* When the New York Central lines paid the various locomotive and car manufacturing companies approximately $31,000,000 for equipment and material furnished in the year 1907, the railroad paid every farthing of freight that had accrued on every pound of iron and steel from the time the first pick was struck into the ground that mined the ore; it paid the freight on every foot of lumber from the time the axe was struck into the tree from which the lumber was cut, and it paid the freight on every dollar's worth of provisions used and clothing worn by the employes of these companies and their families while working on this equipment."

This is as absolutely true of the housekeeper in Chicago or the farmer 100 miles west of the Mississippi as it is of the New York Central lines. An increase that will add half a billion dollars a year to the income of the railroads can not be made without effect upon the men who pay the freight, and the logic which makes this effect seemingly vanish is false. As well argue that reduction of wages would not be felt because, for an hour's time of a cheap man, it would amount to but a fraction of a cent.

Salvation for the Railways.

IT is most strange that in almost all the discussion of this vital question, attention has been focussed upon only two ways of forcing into parallel what Mr. Brown strikingly terms "the converging lines of cost and compensation in railroad operation." These two ways are paying less to employees, and exact-

ing more for service performed. Little has been said of the third, and by far the greatest, way of remedying the case — the way which would be at once sought by a manufacturer paying standard wages and making standard goods in a competitive market, if he found his balance sheet evidencing similar trouble. This way is the systematic, thorough-going reduction of "costs of production" by the policies and methods that have been made familiar practice in industrial engineering. The opportunities for such betterment in railway operation are suggested in Harrington Emerson's article, in this issue, and were amplified by further instances in his interview recently published in the New York *Times*. Examples of an enlightened spirit and an active reform, such as are afforded by the Santa Fe, by their rarity and the brilliance of their results prove the generality of the rule and the vastness of the opportunity. The narrow income of railroads throughout the country is to a very great extent due to ignorance of, or indifference to, efficient methods of handling business and administering their property. They have wasted their substance by spendthrift ways, and now, finding their pockets empty, they wish to put their hands into the pockets of shippers or employees. If they secured an increase of gross income, they would promptly dissipate it. A spendthrift can not be cured by giving him money. The reform must be in the methods of handling the money he has. Higher economy — wholly feasible increase in efficiency—in railway management and operation has possibilities vastly greater than anything yet advanced in conferences between shippers and railway officials. It would probably mean increase in wages of employees. It might possibly mean reduction of freight rates. It would certainly mean that the "lines of cost and compensation" for the roads themselves would become divergent, instead of convergent; and the future of expansion and prosperity which such lines would embrace is incalculable.

A Nation of Spendthrifts.

IT needs a shock, and sometimes a severe one, to waken the prodigal to his folly in wasting his substance. Too often he comes to himself only after the substance is all gone. It may be so with us nationally, so far as concerns our forests and the water resources closely dependent upon them. The wiser example of our older brothers in Europe we hold in light esteem, and to the increasing warnings of flood waste and water famine we blind our eyes, and go on elsewhere with the same policy of destruction. But it is hopeful that public interest is centering on the questions of forest and water conservation, and even more hopeful that strong, organized interests may be enlisted on that side. The enormous importance of the question has perhaps never been better exhibited than in the group of articles by Mr. von Schon now appearing in this Magazine. To an able and authoritative demonstration of the practical results attainable, and an impressive exhibit of the quantities and unit costs involved, he adds proof of the absolute interdependence of the great propositions — forest conservation, water supply, flood prevention, power development, and navigation; and with all he offers constructive criticism in the form of a definite proposal for ready means of solution.

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

THE GEORGIAN BAY CANAL.

A SUMMARY OF THE OFFICIAL REPORT RECENTLY PRESENTED TO THE CANADIAN PARLIAMENT.

Engineering News.

THE first official report on the Georgian Bay Ship Canal project which, though first promoted as a private enterprise, has been under careful examination by the Canadian Government for a number of years, was presented to Parliament on July 6. It proposes a waterway at least 22 feet in depth for the "dam and lock" system of navigation, the whole being so designed as to enable boats 600 feet long, 60 feet wide, and 20 feet draft to pass from Lake Huron to Montreal, advantage being taken of the natural channels which can be made to form 80 per cent. of the distance. The report embodies the results of careful surveys and estimates made on this basis. The following details of the scheme are taken from a summary report which appeared in *Engineering News* for July 16.

"Of the 440 miles of projected navigation between the above-mentioned points, from 410 to 420 miles follow the course of some river or lake. For that part of the route from Georgian Bay to the Height of Land separating the Great sheds of the Ottawa River and the Great Lakes, a distance of 81 miles, the French and Pickerel rivers and Lake Nipissing are utilized. From Lake Nipissing through the Height of Land, for a distance of 3½ miles, the route is an artificial waterway, with the exception of a few small lakes through which it is located. This artificial cut leads into Trout Lake, the Little Mattawa River and Talon Lake, which is utilized as far as Sand Bay at its southern end, a distance altogether of 21 miles, Trout and Talon lakes referred to above being very deep and fairly large bodies of water.

"From Sand Bay there is a canal for 3 miles to the Mattawa River, which is utilized as far as the town of Mattawa, a distance of 13 miles, where another canal cut of ¾ mile in length makes an entrance into the Ottawa River. This river, which expends into large and deep lakes in many places, is followed all the way down to the foot of the Lake of Two Mountains, a distance of 293 miles.

"From the foot of the Lake of Two Mountains to Montreal, a distance of 25 miles, either the St. Lawrence River or the Ottawa River, called Rivière des Prairies, flowing north of the Island of Montreal, may be utilized. The former route is five miles of artificial waterway and the latter about eleven miles. By the first route the canal enters Montreal Harbor at its upper end. By the second route the St. Lawrence Ship Canal is joined at Bout de l'Ile, some eleven miles below the eastern boundary of Montreal Harbor, or seventeen miles below the city Custom House."

The distance from Fort William to Montreal by this route will be 934 miles, a saving of 282 miles over the Lake Erie and Welland Canal route, and 424 miles shorter than the distance to tide water at New York via. the Erie Canal. The distance from Fort William to Liverpool

via. the Georgian Bay Canal will be 4,123 miles, 806 miles shorter than by the New York route. It is estimated that the time of passage from Georgian Bay to Montreal will be 70 hours, 1 3/5 to 2 days shorter than the time of transit from the Great Lakes to an ocean port by any existing route. It is probable, however, that practically the same time could be made by the St. Lawrence route if the latter were improved to a depth of 22 feet, assuming that the number of locks would be greatly reduced thereby.

"The total length of what may be termed canal cutting for the entire route is about 28 miles, by the project connecting the St. Lawrence River above Montreal, through Lake St. Louis, and 34 miles should the Rivière des Prairies route be selected. The length of submerged channels to be excavated is about 60 miles in stretches of varying lengths. Apart from this there is an aggregate of 14¼ miles where obstructions such as shoals, sharp bends, etc., have only to be removed to form very wide channels. Therefore, of the 440 miles constituting the waterway, 108 miles will require excavation work for locks, approaches, canals, submerged channels, etc., leaving 332 miles of natural river or lake channels, which will not require any improvement beyond the raising of the water surface as recommended in connection with the project. Taking into account the 14½ miles of obstructions which, after removal, will leave wide, free channels, the route may be subdivided as follows, in relation to width:

	Miles.
Canal cuts, 200 to 300 feet wide, including necessary restrictions at locks.....	28
Improved channels, submerged sides, 300 feet wide	66
Free channels, 300 to 1,000 feet wide and over	346
Total	440

The relative length of canals and submerged channels may be varied slightly as it is an open question as to the exact point where the one ends and the other begins.

"The sides of all submerged cuts will be shown by piers or clusters of piles at suitable distances to indicate the channel, and to aid the vessels in navigating. Along curves these piers will be provided and each different course will be defined by ranges. The restricted channels are widened at all ends, and conditions for navigation in these restricted parts will be as good, it is expected, as on the St. Mary's River or the St. Clair and Detroit River channels. The depth of 22 feet selected for the waterway will more than equal the conditions as they exist to-day in the channels connecting the waters of the Great Lakes, the St. Mary's River, Hay Lake, St. Clair Flats Canal, and the Detroit River.

"The mileage of excavation in canals and channels for the route may be subdivided as follows for each class of material encountered:

"Dry Excavation — Rock, about 25 miles; earth, about 13 miles; mixed earth and rock, about 20 miles; total, about 58 miles.

"Wet Excavation — Rock, about 18 miles; earth, 16 miles; mixed earth and rock, 16 miles; total, 50 miles; grand total, 108 miles.

"This mileage includes all points which are to be dredged or excavated, whether canal cuts, submerged channels or shoals. A small percentage of the excavation given as submarine rock work might possibly be done in the dry, and the cost, therefore, reduced. In the estimates, when doubt existed, the rock excavation has been invariably classified as wet rock.

"The summit level embraces Lake Talon, the Little Mattawan River, Turtle and Trout Lakes, their present surfaces being raised to elevation 677. Talon Lake will be raised 41 feet and Trout and Turtle about 15 feet above their present level. The locks at both ends of the summit are designed to allow of the large lake thus created, being lowered to elevation 671, without interfering with navigation. In fact, besides affording a wide and unobstructed route for shipping in transit, the lake will have two important duties; to absorb part of the excess in floods and to store the reserves for the months of deficient water supply.

"From the careful hydraulic investigations made, the available supply from the summit watershed, with the storage provided, will be 540 cubic feet per second throughout the season of navigation, which will allow of an average of 24

passages per day or 5,040 passages for the navigation season, estimated to average 210 days per year. As the traffic develops, in the event of this supply being insufficient to meet the demand upon the summit, the supply can be augmented by 700 cubic feet per second by creating storage reserves at the head of the Amable du Fond River, and diverting it from the present outlet into the Summit Lake. This can be accomplished at an expenditure of $900,000. These two sources of supply will more than meet the requirements at the Summit, should the waterway ever be worked to its full commercial capacity.

"The difference in elevation of 659 feet between Montreal and the summit level, and of 99 feet between the summit and Georgian Bay is overcome by 27 locks ranging in lift from 5 to 50 feet. By the Rivière des Prairies route, however, this number is reduced to 26. All locks are designed to be built of concrete. Regarding their size, lake boats have attained a length of over 600 feet, and the minimum dimensions of lock chamber should not be less than 650 feet in length by 65 feet in width. The estimated cost of the locks is based on these dimensions, but in the final report the additional cost of building these locks 800 feet in length by 75 feet in width, should it be found desirable, will be given. In all cases the depth of water on the sills will be 22 feet at extreme low stage.

"The navigation scheme requires the building of 45 dams of various sizes, not including those which will be required in connection with the system of storage reservoirs. Generally, where the quantity of water is much above the canal requirements, the rock-filled type of dam has been adopted. Where, however, it is important to economize water for lockages, concrete dams have been designed. The estimated cost is based on these two kinds of dams and the stop log system of regulation of sluices has been adopted throughout, with the exception of a few locations where Stoney sluices are deemed necessary."

It is intended, in connection with the navigation project, to create large storage reservoirs to control the flood waters of the Ottawa River. These reservoirs will have an important effect on the development of water powers also. It is expected that the concentration of fall and other improvements will render possible the development of at least a million horse power along the Ottawa and French rivers. Under present conditions it is not likely that more than 150,000 horse power could be developed at minimum flow. A certain sum has been placed in the estimates to cover claims for damages to the power concessions already granted and the cost of permanently flooded ground.

"A careful analysis of the work to be performed, shows that it would take from three to five years to develop all contracts and place the whole route under active construction. Some of the sections where heavy submarine excavation is encountered would require at least five years to complete under the best conditions of labor and equipment. It may be fairly stated, therefore, that a period of ten years from inception would be necessary to open the waterway to navigation. This would mean an average expenditure of about ten million dollars per year.

"The cost of the canal is estimated at $99,639,000 if the route via Ste. Anne de Bellevue, Lake St. Louis and the St Lawrence River is followed to Montreal. If, however, the other mouth of the Ottawa River known as Rivière des Prairies is followed, the cost is estimated at $93,890,000. In either case $900,000 will have to be spent for a feeder at the summit of the canal, when this is required.

"The land damages are partly covered by the estimate and partly by contingencies. In most cases of undeveloped water powers it has been assumed that owners could be compensated by being granted power privileges at the nearest dam. The cost of damages cannot, however, be well defined. In ten years from now it is likely that the damages to pay would be much larger, as conditions on the river would be much more involved. This amount cannot be well foreseen. It might be larger than estimated by one or two millions, according to conditions at the time of construction and the legal view taken of some of the claims.

"The geology of the lower 200 miles of the Ottawa River creates seven main steps, at each one of which one or more locks are required. The estimated cost of the Montreal reach from the Custom House to Verdun is $3,859,000, including the lock at Montreal costing $1,090,700. The Lake St. Louis reach from Verdun to Ste. Anne's, a distance of 19 miles, is estimated at $12,553,000, of which $1,093,000 is set down at Verdun to gain the level of Lake St. Louis. The impounded basin from Point St. Charles westward afford an upper harbor five miles in length. The western part of Montreal above Victoria Bridge would be protected from high water by the Verdun dyke. The new lock would have to be built at Ste. Anne, costing $784,800. The cost of the section from Ste. Anne to Port Fortune, 25 miles, is estimated at $2,334,000. Locks at Port Fortune and Hawkesbury furnish the means of rising over the Vaudreuil ridge from Oka Lake to the long reach below Ottawa, a distance of 60 miles. The ten-mile stretch past the Long Sault Rapids would cost with the locks $3,860,880."

BRIDGE ERECTION BY THE END-LAUNCHING METHOD.

A DESCRIPTION OF THE ERECTION OF THE FRENCH RIVER BRIDGE BY THE LITTLE USED PROTRUSION METHOD.

C. N. Monsarrat--Canadian Society of Civil Engineers.

THE little used protrusion method of bridge erection was employed by the Canadian Pacific Railway during the past year in the construction of a single-track span, 412 feet 8 inches long, over the French River, at a point where the depth of water prohibited the erection of false work. As this is one of the longest spans ever erected in this way, the following details of the method employed, taken from a paper read by Mr. C. N. Monsarrat before the Canadian Society of Civil Engineers on April 16, will be found of great interest.

"On account of the great depth of water, it was not possible to build falsework and erect the span in its proper place, so after due consideration of several possible schemes of erection it was decided to erect the span on the north approach embankment, on the centre line of the bridge (produced) and launch it forward by supporting the forward end on a large scow, and sliding the rear or north end on a skidway of greased rails. The embankment immediately north of the north abutment was a new fill consisting mainly of boulders, coarse gravel and sand, with a maximum height of about 25 feet against the abutment, running out to the natural surface of the ground about 100 feet north. The width of the embankment at subgrade was 16 feet, and in order to provide a proper bearing for the skidway, it had to be widened to 26 feet. On this specially prepared roadbed two parallel skidways, about 316 feet long, were built, 10 feet center to center, each consisting of railway ties about 15 inches on centers, with a 12 by 12-inch timber, 16 feet long, every 10 feet to tie the two skidways together. On these ties were laid five lines of 12 by 12-inch longitudinal timbers, over which was laid a flooring of 3 by 12-inch planks, supporting seven lines of 80-pound rails, laid with joints staggered and securely spiked and bolted together.

"The steel work was accordingly erected on the embankment, using a specially designed traveler consisting of two 60-feet boom derricks of ten tons capacity each, mounted upon a timber framework designed to travel on rails gauged 14 feet centers, the platform of the traveler being placed 12 feet 7 inches above top of rail so that lorry cars loaded with bridge material could readily pass underneath on standard gauge railway track and the material be picked up by the traveler booms. Each of the 60-feet boom derricks was handled by separate double-drum engines placed at the rear end of the traveler and forming part of the 20 tons of counterweight on each side required to provide for the uplift due to loading the boom derricks. The assembling of the span on the embankment was, in itself, quite a difficult

operation, on account of the large size of the members to be handled, some of them weighing as much as 40 tons. Before any work was started, the order in which each member was to be erected was fixed and clearly shown on the erection diagram. In order to permit of supporting the forward end of the span by the scow, it was necessary to erect it with its south end projecting over the water about 103 feet. The bottom chord and floor systems, excepting that portion overhanging the water, were first placed in position by means of a self-propelling derrick car, ties were then laid for temporary track on the steel stringers, and the traveler erected with which the balance of the span was assembled.

"In order to place the scow at the proper elevation under the projecting end of the large span, it was necessary to depress it about 4 feet by pumping in water. As this water ballast would render the scow unstable transversely until it took a bearing under the 415-foot span, it was necessary to use a small balancing scow, which was placed at the north side of the large scow and secured to the latter and the stiffening span, by means of diagonal and horizontal struts, and was equipped with counterweight and adjusting screws to provide for any raising or lowering of the large scow. The general dimensions of the large scow, referred to, which was built at the site, were: Length, 155 feet; 33 feet beam, and 12 feet deep; made in two sections for convenience in launching. It was built of 12 by 12-inch timbers for the ends; bulkheads and intermediate frames, 6 by 12 inch sheathing on the sides, 4 by 12 inch for the bottom, with joints staggered and secured to the framing with ⅝ by 12-inch lag screws. The bulkheads were spaced 22 feet 1 inch center to center to conform with the panel points of the 150-foot through riveted truss span, which was erected on the scow as a supporting span, each panel point being blocked on a cross bulkhead. All seams in the sheeting, up to about 2 feet above load water line, were calked with oakum.

"On the completion of the assembling of the large span, the traveler was taken down, the ties used as temporary floor removed, and all field connections excepting end portals and sway bracing, were riveted before launching was started. The ⅞-inch field rivets, of which there were approximately 60,000, were driven by means of pneumatic riveting hammers, a compressed air plant having been installed for the purpose.

"The scow was equipped with boiler and double-drum hoisting engine, as well as a centrifugal pump with 8-inch suction and 6-inch discharge pipes, and a sluice arrangement located over the double bulkhead forming the ends of the two component parts of the scow by which the water pumped in could be controlled and directed into either half of the scow. Each intermediate bulkhead had an 8 by 8-inch hole near the bottom so as to equalize the water in each compartment.

The load from the south end of the 415-foot span, and the 150-foot stiffening truss supported by the scow, was about 1,000 tons. The load from the north end of the span, amounting to about 640 tons, was transmitted to the skidway through two large fixed end cast-iron shoes (used temporarily for the purpose), placed 10 feet center to center, under the end floor beam, which had been designed with a special view to such use. This arrangement of the castings left a clear space under the truss bearings for landing of the span on oak blocking over the bridge seats preparatory to its being jacked down to its bearings. The oak blocking was required for the temporary support of the span at an elevation about 8 feet 5¼ inches higher than its final position, this height being necessary to permit the skidway to pass over the parapet wall of the abutment. Between the aforementioned cast-iron shoes and the skidway rails was placed a ⅞-inch steel plate, large enough to include both castings, with strips riveted to its under side to form guides to engage the rails on the skidway.

"When the scow was in position under the overhanging end of the main span, in front of the north abutment and transverse to the center line of the bridge, two guide anchors were located on the opposite shore at an angle of 45

degrees. Holes were drilled in the rock and 3½-inch steel bars were grouted in a vertical position. To each of these anchors was secured a two-sheave steel block carrying four lines of ⅝-inch wire cable, forming the forward guy lines which were wound up simultaneously on the drums of the hoisting engine on the scow, as the span moved forward, steadying the floating end from any effect of wind or current.

"The tackle used to haul the 415-foot span into position consisted of two specially-constructed steel pulley blocks, having 14 sheaves each, through which was reeved a ⅝-inch diameter steel wire cable 1,000 feet long, with a fall line leading back to the drum of a hoisting engine located on the land at the north end of the skidway. This engine was a 32 horse-power double-drum hoisting engine, with two cylinders 8 by 12 inches, boiler 41 inches in diameter by 108 inches high, and capable of pulling 8,000 pounds on a single line.

"One of the large blocks was secured to the skidding plate under the castings, and the other to the rear end of a string of bottom laterals—belonging to a 250-foot through span designed for the crossing of the Pickerel River, a short distance south of the French—consisting of two angles 6 by 4 by ½ inch each, used as pulling links. These were in turn secured by a pin to a box girder supported by struts in front of the north abutment. Each section of these laterals was about 30 feet long, and when the two large blocks were brought together one or two sets of lateral links were removed and the blocks overhauled. When the last section was reached it was removed, and the forward block secured by the pin direct to the box girder.

"When everything was in readiness, on the evening of October 27, 1907, the scow was pumped out by means of the centrifugal pump, until the span was raised off the blocking. When this occurred it was found that there still remained a foot of water in the scow, showing that an ample margin of buoyancy had been allowed. At 8 a. m. on the 28th, the engine was started, and with the assistance of a slight shove from two 40-ton hydraulic jacks, the large span started on its way, moving on the well greased skidding rails at the rate of 4 to 6 feet per minute. Considerable time was lost owing to the inability of the small boiler of the hoisting engine to keep up sufficient steam pressure and also in the overhauling of the very heavy tackle.

"The actual time occupied in moving the span was 3 hours, and in overhauling tackle, etc., 4 hours. The span was landed on its blocking at 4:05 p. m., without a hitch of any kind.

"Trouble had been anticipated with settlement of the skidway on the new dump in view of the 640-ton concentrated moving load passing over it, but in no case was the settlement over six inches, and it was uniform at both sides, the greatest variation of the span from the level being about ⅛ inch in its width. So smoothly did the span move that it was possible to set it in its final location with the engine alone, without the assistance of jacks, and by means of the steering control afforded by the forward guy lines the span was within ¾ inch of its proper alinement when landed on the main pier on the south side of the river.

"The lowering of the span to its final bearings on the bridge seats was accomplished by means of two specially-constructed 500-ton hydraulic jacks. After the span was landed on the wooden blocking, the skidway, castings, and skidding plate were removed and cast-steel cap plates were bolted to the under side of the floor beam, these plates being turned out to fit over a cast-steel disk plate 23 inches diameter by 3½ inches thick, placed on top of the plunger of each jack; between the bottom edges of these disks and the shoulders of the jack cylinders were placed a number of ¼-inch steel plate half-ring shims, as a safety precaution against accident should anything go wrong with the jacks; in which event the weight would be transferred to the massive jack cylinders.

"The jacks were each placed on blocking consisting of three super-imposed steel cylinders filled with concrete, over which were placed a number of cast-iron cellular blocks 2 feet 10 inches in diame-

ter by 3½ inches thick. The ¼-inch shim plates were removed one at a time as the span was lowered so that in no case was there left a space greater than ¼-inch between the under side of the disk and the jack shoulders. Before the last of these shims was removed the span was landed on the oak blocking, the jacks released and one or more sections of cast-iron blocking removed, the jacks pumped up, shims replaced, and the operation repeated until all the cast-iron blocking had been removed, when one of the concrete-filled cylinders was taken out, the casting and shims replaced, and so on until the span was landed on its permanent shoes. The oak blocking was also removed as the span was lowered, the top of it being kept high enough to free the jacks while shims were being adjusted.

"When the span had been lowered about 4 feet at one end, the jacks were transferred to the other and similar operations carried out there. That end, however, was lowered right down to the shoes before the jacks were returned to the end first lowered."

THE CO-OPERATIVE COURSE AT CINCINNATI.

AN OUTLINE OF THE RESULTS AND LESSONS OF TWO YEARS' EXPERIENCE.

Herman Schneider—Society for the Promotion of Engineering Education.

THE discussion on Mr. M. W. Alexander's paper outlining a proposed coöperative system for teaching electrical engineering, read before the recent convention of the American Institute of Electrical Engineers and reviewed in these columns last month, disclosed the fact that nearly every college professor and a number of representatives of large manufacturing companies present at the meeting doubt that the system would be successful in producing the highest type of thoroughly trained engineer. In this connection it is interesting to read the testimony of Prof. Herman Schneider as to the results and lessons of two years' experience with the coöperative system in mechanical engineering at the University of Cincinnati, contained in his recent paper before the Society for the Promotion of Engineering Education. It will be remembered that at Cincinnati the students in the coöperative course spend alternate weeks in college and shop, the whole course covering six years. According to Prof. Schneider, the manufacturers of Cincinnati have taken very kindly to the plan and have lent the college authorities most cordial support and assistance. Their advice has been particularly valuable in selecting from the hundreds of applicants the men best suited to the profession of engineering. In a sense the students in the coöperative course are picked men but the results outlined by Prof. Schneider are none the less interesting and valuable on that account. He says in part:

"It is hard to make an accurate determination of the relative efficiency of instruction in the four-year and the coöperative courses. The records in one or two subjects, however, will indicate about what this would be. In calculus, for instance, not one of the coöperative students failed. The lowest grade received by any coöperative student was 73 (60 being the passing grade and 100 the maximum), and fifty per cent. of the class received over 90. In the regular four-year engineering course, on the contrary, about twenty per cent. of our students failed in calculus and few received a grade above 90. In this connection the fact should be noted that the examination given to coöperative students was harder than that given to the regular students. In chemistry the coöperative students and the regular students have exactly the same examination. Ninety per cent. of the coöperative students passed and about eighty per cent. of the regular students. This need not be astonishing, for, with few exceptions, the coöperative course is not carrying any dead wood. It will be seen, therefore, that since the efficiency of the instructor depends primarily upon the amount of actual substance absorbed by the class, it is increased very considerably in the coöperative courses.

"When this system was started two years ago many questions of detail arose. For instance, the matter of the rearrangement of the college courses was taken up. It was concluded, however, that the best thing for us to do would be to learn by experience. We are happily being driven from traditional methods by the students themselves. Here is a sample of what happens:

"The instructor in mathematics covers the blackboard with the demonstration of a long formula, and when he has finished it he turns to the class and asks, 'Do you understand that?' The class replies that it does, but inquires seriously, 'What shall we do with it?' This has happened a number of times, and at first caused much annoyance to the instructor; but when it was pointed out to him that if a thing had no use it was useless and should not be taught in an engineering college, light dawned on him, and he now spends much of his time hunting practical exemplifications of theory.

"This is the characteristic attitude of the coöperative student, and it is not surprising. Our four-year students are accustomed to being handed a formula which they hold, until examination time, when they hand it back. The coöperative student in the shop is handed a tool and is instructed how to use it. He uses it, hands it back to the tool-room, and thereafter knows where to find the tool and how to use it. When he is handed a formula or a theory at the university it is a matter of second nature to him to expect to be shown how to use that formula or theory prior to his handing it back. Thereafter, as with the tool, he knows where to find it and how to use it.

"We have inaugurated what we call the 'reverse quiz' in class. Toward the end of the hour students are given permission to ask any questions that have a bearing upon the subject, and this has been perhaps the most valuable addition to our system. It is, of course, uncomfortable for a young instructor, but if he is the kind of a teacher our engineering college ought to have, he will work to meet the situation. The shop knowledge of the student has demonstrated to us the fact that some of the instruction in our colleges is not only frequently out of date, but also that it is as often absolutely wrong. You will observe that there is a check upon the instructor's work which cannot be had in any other way except through this practical knowledge of the student.

"The questions of these young men have caused us to change our courses and will cause many more changes as the work advances. Mathematics, for instance, is taught as one subject, the fundamental principles of university algebra, trigonometry, analytical geometry, and calculus being given during the first part of the freshman year; and thereafter any one formula is derived by the different methods. The course in mechanics is taught as part of the course in calculus. Descriptive geometry and machine drawing will hereafter be given as one subject, because when a student was given a problem in descriptive geometry he wanted to know its application, and when told the application, wanted to know whether he could not put it at once on the same sheet.

"It will be seen, therefore, that while we simply took the four-year course at the beginning and spread it over a period of six years, we are changing it considerably by reason of the experiences which we have in every day class work.

"It has become evident also that it will be necessary to bring some of the engineering work down into the earlier years. As a counterbalance to the essentially practical attitude of the student we have inaugurated a broadening course in the social, economic, industrial and political development of the human race, together with courses in biology and geology. It was originally intended that this course should cover a period of three years, but we are now inclined to give it through the entire six years.

"The alternating periods were fixed at one week tentatively, and this has proven very satisfactory. A vote of the students was recently taken, and they were unanimously in favor of the one-week period as giving them the proper alternation of mental and physical work. They also state that absence from the shop for more than a week allows their muscles to become soft, and for this reason they prefer to continue on the week

system. The shop also desires to keep this period of one week, because if the period were made longer at the university the student would lose some of his skill by the time he returned to the shop. It has been definitely concluded, however, that when the young men go into the designing and sales offices — which will be about the fifth year—the alteration will be semesters. It will be impossible for a young man to work in a designing or sales office with any benefit to himself or to the firm for a shorter period than six months. The students in the coöperative course will then enter the regular classes at the university, when a better comparison of the work of the two classes of men can be made.

"Since the coöperative student is at the university for a period of three years, as compared with four years of the regular student, it became evident, of course, that he would be required to do more actual class and laboratory work per week than our regular students. Additional hours were given to him during his alternate week at the university, and the roster was considered by some of our faculty to be too heavy. At the end of the first year, however, the students finished without any seeming effort and with much better records than did our regular students. This year a further experiment was tried by the writer on the freshman coöperative class by giving them work every period of the day from 8:30 until 5 o'clock, with one-half hour for lunch, except on Saturday morning, when they work from 8:30 until 10:30 o'clock. This, it will seem, is about the heaviest roster the student can possibly carry. At the end of the year the men were more vigorous, mentally and physically, than they were in September. They were more active in university social affairs, athletics, and general student life than the regular students, and they had made much better scholastic records.

"The fundamental principle underlying this course is based upon the rational assumption that the proper way and the only way for a young man to learn the practical side of his profession, together with business details and an intimate knowledge of the labor problem, is by working as a regular employee in a commercial shop; and further, that the only place where he can learn properly the scientific and the cultural subjects is at a school under trained teachers. This further implies that the school work and the practical work should, as far as possible, go hand in hand, so that the young man may step from school to business just as readily as he does from one promotion to another in after life. The writer believes this principle to be all-important and to apply to all engineering and industrial education."

THE QUEBEC BRIDGE DESIGN.

EDITORIAL COMMENT ON MR. C C. SCHNEIDER'S REPORT TO THE CANADIAN GOVERNMENT.

Engineering News.

TO supplement the exhaustive investigation of the causes of the collapse of the Quebec Bridge carried out by the Royal Commission of Inquiry, a summary of whose report was published in these columns in April, the Canadian Government caused to be made a full investigation of the Phoenix Bridge Company's design. This work was intrusted to Mr. C. C. Schneider and his report has recently been made available by the publication of a blue book containing the reports of both inquiries. Mr. Schneider's report is abstracted in *Engineering News* for Aug. 6. We present below the editorial comment on his findings contained in the same issue, which enumerates and discusses the main points dealt with by Mr. Schneider.

"Mr. C. C. Schneider's report on the design of the Quebec Bridge amply confirms the general opinion with which that ill-fated structure has been regarded since the searching investigations of the Canadian Government's commission of inquiry. The Commission found that the bridge had turned out to be some 20 per cent. heavier than was contemplated by the stress-sheets. Although the col-

lapse was shown to be due to quite another cause, such an overrun of dead weight, in a structure whose own weight constitutes by far the largest part of the load it has to carry, is unavoidably fatal. With the bridge fully completed and in service, the stresses would have risen to the limit of strength of the members, and if it did not at once fall, it could at best stand trembling on the verge of collapse.

"The computed percentages of excess stress from Mr. Schneider's report reveal this clearly enough, though the actual stress figures themselves are rather more striking. In this place we may present as typical illustrations two selected examples, a compression and a tension member, respectively. One of these is the famous lower-chord member in the ninth panel from the anchorage (second panel of the anchor arm counting from the main pier), the member whose failure by buckling brought about the fall of the bridge. The other is the top chord of the cantilever arm directly adjoining the main pier. The figures of total stress give a picture of the relative importance of dead and live-load, while the unit-stress figures represent directly the tax on the metal. In considering the latter, it is convenient to remember that the elastic limit of the steel—its real or virtual failure point—is not far from 30,000 pounds per square inch. But the figures below, while they do not quite reach this point, really exceed it because they contain no allowance for the numerous minor effects, the so-called secondary stresses.

	Anchor Arm Lower Chord, Panel 9.	Cantilever Arm Lower Chord, Panel 10.
Section, sq. ins.	781	669
l/r	42.2	...
Total stresses, thousands of pounds:		
Dead-load	—13,690	+11,950
Live-load	{ +43 / —4,021 }	+3,760
Snow	—1,025	+930
Wind	—7,370	+1,140
Unit stresses, pounds per square inch:		
D + L + S	—24,000 (21,200)	+24,900 (21,100)
D + 1½ L + S + 1/3 W	—29,700 (24,000)	+28,300 (24,000)
Erection, Aug. 29, 1907	—16,800	+17,500

"The figures in parentheses are the stresses which were permitted in these members for the respective load-combinations, under Mr. Cooper's specifications. Mr. Schneider's estimate of the highest stress intensity compatible with bare safety is not far different from these specified stresses, in the case of the eyebar chord; but for the compression chord his values are lower by some 4,000 pounds per square inch.

"We need do no more than point to the fact that in the eyebar chord the stress even under the working load, and without wind, is higher by 1,000 pounds per square inch than the extreme or emergency strength estimated by Mr. Schneider. Still worse, in the compression chord, whose emergency strength is valued at slightly less than 20,000 pounds per square inch, the working load causes a stress of no less than 24,000 pounds, and the stress under extreme load rises practically to 30,000 pounds per square inch, fully one-half higher than the extreme assignable strength.

"Let it be remembered that Mr. Schneider's figures for limits of permissible stress are intended as real limits, and would by no means be defensible or admissible in the design of a bridge. '*The writer does not advocate these high unit-strains,*' we read in the report. And while this warning is unobtrusive, we conceive it worthy of very strong emphasis. Tendencies in recent years toward the regular use of very high unit-stresses in design, even in cases where economy of weight is of no particular importance, receive a sharp but needed rebuke in this brief sentence.

"Under the circumstances as revealed by the stress analysis, there will be few to raise objection to Mr. Schneider's statement that none of the material which has been fabricated for the north half of the bridge can be used in rebuilding the structure. The strengthening which would be necessary if the trusses were to be rebuilt on the same outline, but with adequate cross-sections, would have to extend to virtually every part except floor and bracing. Even this extensive work—if it is to be considered feasible at all—would involve so many difficulties that the result could but be an unsatisfactory patchwork. And if patchwork and halfway measures are ever justified, assuredly they must be

kept out of the rebuilding of the Quebec bridge. The engineering world can hardly afford to contemplate the chance of a second Quebec disaster.

"The most difficult subject which the eminent bridge engineer who wrote the report had to deal with is, curiously enough, the one which he treats most briefly: the suggestion for a new design. It may be premature to ask for anything very specific in this matter at the present stage, or in any case without giving time and opportunity for exhaustive studies. But the existing design, originated both in general outline and in details by the Phoenix Bridge Company, stands criticized, and one looks very naturally for justification of the criticism in the shape of suggestions for better design. Yet we find hardly more than a single suggestion in the report.

"An explanation for this which has some force is to be found in the fact that so huge an undertaking as this bridge is by no means susceptible of systematic and progressive designing. The design must, in a sense, be evolved by a process of development, a sort of trial and error method. In a structure of ordinary dimensions the engineer knows in advance all of the limitations which will affect his work, and can allow for them in his planning in advance. But in the present case the limitations appear only as the design unfolds. The necessary arrangement of the details, the limits of manufacturing tools and processes, the shipping limits of weight and bulk, the erection problems, etc., have an influence even on the choice of outline that is easily underestimated; yet their full bearing cannot appear until an outline is adopted and has been elaborated to an advanced stage. The testimony of the Phoenix Bridge Company's designers before the Commission gives some idea of these conditions. It seems idle, therefore, to seek a very full statement of governing features as a matter of abstract deduction.

"The recommendation of straight chords must enlist general approval, as being unexceptionable in its general reasoning. But it fixes a principle hard to adapt to the original requirement that the maximum under clearance is to be maintained over so great a width as 1,200 feet, two-thirds the span. The two conditions together would produce a remarkably radical design indeed, unless perhaps the changes were begun still farther back and the railway approaches raised to a much higher elevation. If this is true for the present clearance of 150 feet, still more so will it hold if the recent clamor of St. Lawrence shipping interests for increased clearance—to nearly 200 feet, if we recall correctly—is heard with approval. In fact, it is not too much to say that, just as the determinative features of the Phoenix design were fixed by the adoption of sharply-curved chords to meet the clearance requirement, so the principle of straight chords in conjunction with the same requirement would establish the chief characteristics of the new bridge. The single suggestion, therefore, may well appear complete and sufficient for present purposes.

"There should be joined to this, we believe, another principle which is clearly inculcated by the report, though Mr. Schneider makes no explicit mention of it. This has for its object the reduction of the high secondary stresses. The calculations show that these stresses attain alarming values — alarming when we consider how destructive they are to economical, and therefore practicable and safe, design. In a bridge of such proportion that each pound of useless metal requires three or four pounds of effective metal for its support, it cannot be tolerated that even 5 per cent. of the useful metal should be put out of service by being appropriated for secondary stresses, if this be at all avoidable.

"It is true that secondary stresses are inseparable from bridge construction, especially when continuously riveted chords are employed; and the unfortunate fact is that any attempt to make the members stronger to resist the secondary bending, by making them stiffer, defeats its own purpose and actually increases the secondary stress. How high they will be, in proportion to the main stresses, depends, however, to a large extent on the truss outline or network. We believe it may be said broadly that two things are most influential in con-

tributing to high secondary bending stresses: flexibility of the truss system as a whole, and short length of panel. The former creates large angular distortion, while the latter concentrates the distortions. Relief from high secondary stress may therefore be sought by making the truss system rigid and by employing long panels. The former is promoted to some extent by straight chords, still more by increased truss depth; and the profile of the Quebec Bridge clearly evidences that the shallow depth of the structure causes relatively high flexibility. The effect of long panels is obvious.

"Secondary stresses of the intensities as existing in the original Quebec design must, in our opinion, be eliminated in a new design. To this end the two expedients of (1) increasing the depth of truss, and (2) employing larger panels —in the trusses, not necessarily in the floor-system—must receive primary attention in outlining the new bridge."

FLYWHEELS VERSUS STORAGE BATTERIES FOR EQUALIZING FLUCTUATING LOADS.

A COMPARISON OF THE TWO SYSTEMS AND AN OUTLINE OF THE CONDITIONS TO WHICH EACH IS SUITED.

G. C. Allingham—The Electrician.

ON another page of this issue Mr. Percival R. Moses refers briefly to the limitations of the flywheel system of energy storage and finds that it can compete with the storage battery only under very special conditions. A more extended comparison of the two systems is given by Mr. G. C. Allingham in *The Electrician* for July 10, from which we take the following extracts. Mr. Allingham's discussion refers principally to mining work, but the principles he lays down are applicable to any problem involving the choice of a system of energy storage.

"The duty for which flywheel storage is best adapted is that of equalising the power demand of an individual machine, such as a winding engine or a rolling mill, which goes through a definite cycle of operations, repeated throughout the period of working, so that very short periods of heavy and of light load recur alternately in regular succession. In such cases the actual amount of *energy* that has to be stored is very small (although the *power* to be dealt with may be large) and it has to be kept stored up for a very short space of time. Again, the amount of energy to be stored can be calculated fairly closely, and the flywheel equaliser can be designed to suit the load-curve of the machine, so that it is storing and giving out energy alternately almost all the time, and running idle as little as possible. In other words, it is possible to arrange to work the flywheel equaliser at a comparatively high load-factor.

"On the other hand, in cases where the overloads are irregular in frequency and amount; where they may last for longer periods or occur in rapid succession, and may also be separated sometimes by comparatively long periods of low load, flywheel equalisers are not suitable, on account of the small amount of energy they are capable of storing, and their heavy no-load running losses. In such cases, the load-factor on the equalising plant is of necessity low, and the constant running loss being high, the working efficiency must consequently be low. A haulage gear is an instance of a machine whose load-curve is usually extremely irregular, and for which fly-wheel storage would, therefore, not be well adapted; a coal-cutter is another.

"In the case of a coal-cutter, for example, the load-curve shows successions of heavy peaks, alternating with intervals of no load varying from a few minutes to half an hour or more while the cutter is being shifted. Consider what occurs in one of these intervals. Within a minute or two the flywheel is brought up to full speed, by which time it has taken up all the energy it is capable of storing, and afterwards current has to be wasted to keep it turning round at

full speed churning the air until a heavy load comes on again.

"If, on the other hand, an attempt is made to save no-load running losses by shutting down the flywheel set during a period of low load, all the energy stored in the flywheel has to be thrown away, and it will also take a considerable time to get the wheel started up again, so that if a sudden overload comes on there is a risk of being caught unprepared.

"Again, when the peaks are liable to endure for some time, or to come on in rapid succession, the flywheel equaliser is handicapped by its small storage capacity; and if an attempt were made to overcome this drawback by increasing the size of the flywheel, the fixed running losses due to friction and windage would be correspondingly increased, and the efficiency of working would be greatly reduced. The amount of energy which would have to be expended every time the flywheel was started up would also be increased. For these reasons, not to mention the practical difficulties in the way of making flywheels of enormous size, and their prohibitive cost it is impossible to construct flywheel equalisers having any considerable storage capacity combined with a high working efficiency.

"From the foregoing considerations, flywheel storage would appear to be unsuited for equalising the load on a power station supplying a number of motors, since the fluctuations of the power demand on such a station are always quite irregular. Attempts are being made to apply flywheel storage to power plants for electric traction, but, for the reasons given above, the author does not consider them likely to meet with success.

"The alternative to flywheel storage is the use of a storage battery, preferably in combination with an automatic reversible booster. In special cases, such as those mentioned in the second paragraph of this article, where the storage capacity required is very small, a flywheel is of course a cheaper means of storage than a battery. But where the power demand to be dealt with is irregular, the battery equalising plant has the advantage, for, firstly, it has sufficient storage capacity to deal with any combination of peaks and depressions in the load-curve that could possibly occur; and secondly, its no-load running loss is quite insignificant compared with that of a flywheel equaliser, so that the working efficiency of the battery plant is almost independent of load-factor.

"As a matter of fact, there is of course no such load loss in the battery itself, the only such loss being that involved in keeping the automatic booster running, and at times when the load is not heavy enough to make it worth while to run the booster, the latter can be shut down, without any waste of stored energy, and the battery alone will still have a considerable steadying effect.

"A storage battery has the further incidental advantages that it serves as a standby which is capable of supplying power for a considerable time in case of a breakdown, or of an unusually heavy load on the generating plant, and that it often enables the generating plant to be shut down entirely at times of light load, as at nights or over week-ends.

"The point is often raised that storage batteries can only be used on direct-current systems, whereas a large proportion of power plants are three-phase. But it should be borne in mind that most systems of flywheel storage involve conversion to direct current, and that such conversion can be carried out equally well in connection with storage batteries.

"It may be pointed out that, when a storage battery is employed for equalising an alternating power load, it is not necessary to convert the whole of the power load to direct current, but only that portion of it which has to be stored in the battery, so that it is only on that fraction that conversion losses are incurred. An automatic reversible motor-generator or rotary converter may be connected across the three-phase mains, and arranged to keep the three-phase load constant by alternately charging and discharging the battery which is connected to its direct-current end. In the case of most flywheel storage systems, on the other hand, the whole of the fluctuating power load which is to be dealt with by the flywheel has to be converted into direct current; this is notably the case with the Ilgner system."

THE MARINE GAS ENGINE.

A REVIEW OF THE ADVANTAGES AND DIFFICULTIES OF GAS PROPULSION FOR LARGE SHIPS.

Engineering.

CONSIDERABLE interest has been aroused by reports lately published in English newspapers that the Admiralty are contemplating the adoption of gas engines for a battleship soon to be laid down, and, more recently, by a prediction made by one of the fuel experts of the United States Geological Survey that in the near future the ships of the United States navy will be driven by gas power. *Engineering*, in an editorial review of the situation in the issue of July 3, admits that in the past year great progress has been made, but believes that the introduction of gas propulsion on a large scale will be delayed for some time to come, at least until careful and exhaustive experiments have been made on small units. From this article we reproduce the following outline of the advantages and difficulties of the marine gas engine.

"The advantages to be obtained from an installation of large size for marine propulsion are a saving of one-third of the space occupied by machinery, and a reduction of the total weight of machinery of possibly one-fourth. While the engine itself would have to be much heavier than a steam-engine of the same power, the necessary gas-producers would be much lighter than the steam boilers. As the gas-engine and producer have a thermal efficiency about double that of the combined thermal efficiency of the steam-engine and boiler, it should be possible to get a horse-power at the propeller for 1 pound of coal per hour, and also to obtain it from a cheaper grade of fuel than can be used to advantage in a boiler. The last-named advantage will appeal strongly to owners in the mercantile marine, as it will enable the fuel cost of transport per ton-mile to be considerably reduced. Gas-producers, when once charged, will go on making gas for several hours without further attention. In Beardmore's tests on board ship the producer, once charged, runs for ten hours without attention. The same large force of stokers needed for a steam installation of any size will not therefore be required. Where there are many producers they would be charged in succession, and not more than two or three in any one watch. There would be considerably less than one-quarter the amount of ashes to handle in a given time, and there should be no clinker at all. There would be no smoke, and, therefore, the large funnels, with their wind resistance, would not be present. The space usually occupied by uptakes would also be saved. This advantage would be of considerable value to naval vessels by enabling them to almost get into range before their presence could be detected. It must be remembered that each and every cylinder in a gas-engine is a complete engine in itself, and should one or more break down, the disabled cylinder could be put out of operation, and the propeller turned as long as there was a single cylinder left in working order. It is only necessary to remove the connecting-rod, and the rollers that are operated on by the cams, in order to disconnect a cylinder—a much lighter job than would be required in the case of a steam-engine, though the weight to be handled might be greater.

"The disadvantages of gas propulsion for marine use, though many in number, are not by any means insurmountable. The chief objection seems to be the very high temperature that obtains in the cylinders when they are of large size, and the consequent liability of the valves to score and give trouble, finally resulting in a complete temporary stoppage, which would be exceedingly inconvenient, if not dangerous, at sea. There are several methods of reducing this excessive temperature, such as making the engine of relatively long stroke, diluting the charge with a surplus of air or some of the exhaust gases, increasing the volume of water circulating in the jackets and pistons, or injecting water into the cylinder during the combusion, etc. Valves, if of large size, can readily be water-

jacketed. They can also be double-seated, and thus cause the speed of the hot gas through them to be reduced, and the work required to lift them to be lessened. Another objection has been the great size and weight of the crank-shafts and connecting-rods, framing, etc., in order to withstand the heavy and violent shocks incidental to all gas-engines. Here again the relatively long-stroke engine will score, and by adopting a cycle of operations in which heat is added at constant pressure rather than at constant volume, the violence of the shocks can be reduced, and a lower temperature of combustion obtained at the same time. It has been considered a disadvantage that most gas-engines are fitted with trunk-pistons, and that therefore the connecting-rod pin is inaccessible, and the piston, when worn, has to be entirely renewed. But when gas-engines are built specially for marine use, they will be of such a size that they will have thin water-cooled pistons, be double-acting, and be fitted with the ordinary crossheads and slides used upon steam-engines; or if trunk pistons are used, they will be fitted with adjustable shoes to take the wear in the wake of the connecting-rod pin.

"It is generally considered to be a difficult matter to make a gas-engine reversible, but this is only because it has generally been attempted with the usual revolving cam-gear, and on engines of comparatively small size. On large engines, oscillating instead of revolving cams can be used with advantage, and these can be operated by the well-known Stevenson link motion or by the Joy, Marshall, or other radial reversing valve motion, worked by compressed air when the engines are very large.

"A special compressor, driven by an independent gas-engine, will always form part of a marine gas-engine installation, because compressed air will be required for starting the main propelling engines, blowing the whistle and syren, working the reversing engine, circulating and other pumps, steering-engine, capstan, deck-winches, ash-hoists, etc., which are now part of the recognised outfit of the modern steamship. Under certain circumstances, all this work might be done by electricity, in which case a separately driven electrical generator would take the place of the air-compressor. A disadvantage of the gas-engine for marine propulsion is its want of flexibility in the rate of revolution at which it can be driven, but there are several ways in which this can be met, such as cutting off the gas supply to one or more cylinders, building the engine in two or more distinct units which can be readily connected up or disconnected, applying the total power on three or more shafts, so that one may run ahead and two astern, or *vice versâ*, so that a ship of large total power may be run at very slow speed when necessary.

"A mechanical disadvantage of the gas-engine, when used for marine propulsion, is the uneven turning moment, especially when run on the four-stroke cycle. It is, of course much better on the two-stroke cycle, but as in the latter case twice the amount of hot gas has to pass through the exhaust-valve in a given time, special provision has to be made to meet and overcome this difficulty. Three double-acting cylinders, acting on cranks at 120 degrees apart, is probably the smallest unit that can be relied upon to work satisfactorily, and even then it would be necessary to employ a fly-wheel. Another mechanical difficulty is in so regulating the power that it shall follow the sudden variation in the resistance, due to the propeller being partially lifted out of the water when the vessel pitches; but some form of high-speed centrifugal governor arranged to cut out or throttle the gas supply, relieve the pressure in the cylinders, cut out the ignition, or a combination of two or more of these methods, should be able to meet the difficulty.

"What to do with the exhaust from the marine gas engine is also quite a difficult problem to settle, but as the object sought to be attained is both to cool and reduce the volume of the exhaust gases as rapidly as possible, some form of surface condenser, in combination with an injection of part of the cooling water into the exhaust pipe, ought to meet the case. The cooled gases could also be afterwards discharged overboard

below the surface, and thus secure perfect silence. Objection has been made to the gas producer on board ship that poisonous gases are liable to leak out and either kill the crew or cause disastrous explosions, but if operated under the suction system this does not hold, since any leak would be into, and not out of, the producer. If the producers are operated on the pressure system, it is only necessary to surround the producers and all the gas pipes with an outer air-tight shell, and force the supply of air through the intervening space on its way to the producers. In this way any leak that could occur would be pure air, either into the ship or into the producers or gas pipes. If more than one producer were in use, it would be the duty of the attendants to regulate the amount of gas furnished by each, in accordance with the reading of a pyrometer fitted to each one, so that the temperature of combustion in each was the same. This would not be any more difficult than the work of regulating the feed water to a battery of steam boilers."

THE USE OF EXPLOSIVES IN COLLIERIES.

A DISCUSSION OF THE DANGERS INVOLVED AND THE MEANS OF MINIMIZING THE RISKS.

Wm. Maurice—The Electrician.

A SPECIAL mining number of *The Electrician*, published July 10, contains an interesting article by Mr. William Maurice on the risks attending the use of explosives in collieries, due to the presence of firedamp and coal dust. Little attention has been given in the United States to the regulation by the government of the materials and methods of blasting in coal mines but, as Messrs. Hall and Snelling pointed out in THE ENGINEERING MAGAZINE for February last, one of the most potent causes of colliery explosions can be removed by the strict enforcement of regulations based on careful investigation of the nature and behavior of explosives and the characteristics of explosive mixtures of gas, dust, and air. We present below Mr. Maurice's brief outline of the regulations in force in European countries and the results of the researches on which they are based.

"Twenty years ago gunpowder and dynamite were almost the only explosives used in mines, although it had even then been more or less generally recognised that gunpowder was a dangerous agent to use in the presence of firedamp and coal dust. After many disasters had been traced to the use or misuse of explosives, the Secretary of State of the United Kingdom availed himself of Sec. 6 of the Coal Mines Regulation Act, 1896, to issue an order making it unlawful to use any explosive other than a 'permitted' explosive under certain specified conditions on and after July 1, 1897. Concurrently a testing station was erected at Woolwich, following on the report of a Departmental Committee appointed 'to inquire into the testing of explosives for use in coal mines.'

"Explosives to be tested are sent by the manufacturers to this testing station, and if 20 charges of any sample are fired into an explosive mixture of gas and air, under certain specified conditions as to weight and stemming, without causing ignition, the explosive is then entitled to be placed on the 'permitted list.'

"As it is to be feared that many workmen regard the fact of an explosive being 'permitted' as being somewhat in the nature of an official certificate of safety, the following remarks of the officers in charge of the testing station cannot be too often repeated. 'There is not a single explosive on the permitted list which has not at some time or other caused an explosion of gas at the testing station when fired without stemming. It is impossible to get an explosive which will be absolutely safe under all conditions. The safety of any particular explosive depends not only upon its composition and physical characteristics, but even in a more marked degree upon the conditions under which it is used. There must be:

1. Complete and immediate detonation of the charge.

2. Correct proportioning of the charge to the work to be done, and avoiding the use of unnecessarily heavy charges.

3. Careful stemming to ensure that there should be sufficient length, firmness, moisture and closeness of consistency.'

"Thus the only difference as regards safety from mine explosion risks between one explosive and another is the difference in degree; the most that can be said is that one explosive is less dangerous under certain conditions than another. Modern explosives are divided into five principal groups:—

1. Nitro-glycerine explosives, which are relatively easy to detonate under normal conditions.

2. Ammonium nitrate explosives, which occupy an intermediate position between the dynamites and the carbonites.

3. Nitro-glycerine and ammonium nitrate explosives, which detonate more freely than class 2.

4. Non-detonating mechanical mixtures, mainly represented by Bobbinite, which is a high-grade gunpowder mixed with starch and paraffin wax; and

5. Gunpowder, the principal characteristic of which is its low velocity of explosion, rendering it very suitable for work where a slow heaving action is required. All these classes are represented on the permitted list with the exception of gunpowder, which will not pass either the Continental or Woolwich tests.

"The time occupied in detonating a given quantity of an explosive is determinable, and is known as its rate of detonation. All explosives on detonation develop flame, of different extent and duration. M. Bichel, the inventor of carbonite, has conducted elaborate and extensive experiments to ascertain the determining factors in the ignition of firedamp, and finds them in a comparison of the ratios of the safest and least safe explosives as to rate of detonation, length and duration of flame, after-flame ratio, and temperature. M. Bichel has shown that the flame of all explosives outlasts the time of detonation, but that of the 'safe' explosives does so in a much less degree than in the contrary case. 'In general,' he says, 'safety explosives should show a minimum rate of detonation and a minimum of length and duration of flame at a given pressure; none of these should exceed certain limits, as the detrimental effect of one of them cannot be counterbalanced by the others, however favourable. Thus it is the long contact between flame and gas mixture which is fatal to gunpowder in spite of its low calorific value. The heated gases remain too long in contact with the inflammable gas mixture, and thus, even at low temperature, ignition is unavoidable.'

The importance of coal dust as a factor in mine explosion is not yet generally recognized but "experiment has shown that as little as 1/3 ounce of coal dust per 35 cubic feet of air will suffice for the production of an explosion, and that it is more a question of fineness of division of dust than the weight. In addition to fineness of subdivision the percentage of volatile matter in the coal dust has an important influence on its inflammability, and the same also applies to the ease with which these volatile matters are disengaged by heat.

"The Commission appointed by the Société de l'Industrie Minérale to investigate the causes of coal-dust explosions have pointed out that the great danger of explosion presented by floating coal dust is evident from the fact that a mixture containing 111 grammes of dust per cubic metre of air (*i. e.*, in the proportion furnishing carbon dioxide on combustion) develops a pressure of 15.5 atmospheres on ignition, as compared with the pressure of 8.9 atmospheres produced by the combustion of an explosive mixture of firedamp and air. Even when the amount of coal dust is double the above figure, so that carbon monoxide is produced, the pressure generated amounts to 6.7 atmospheres. The fact, moreover, should not be lost sight of that the dust danger is by no means eliminated merely by removing coal dust. Any powdered substance in a state of suspension as fine dust may, by occluding, and so acting as a substitute for, air or oxygen, cause an atmosphere to become explosive. Dust from oil-bearing shales might be especially dangerous.

"Having regard to the facts now known concerning the use of explosives in dangerous atmospheres, the Commission above referred to have suggested that non-fiery mines should be divided into safe and dangerous according to their condition as regards dust, the dangerous class being subdivided into damp and dry mines. In Great Britain the present alternative to watering lies in the conditional use of a permitted explosive. The French Commission approve of local, but not of general watering, and recommend that shot-firing be allowed in coal up to charges of 13½ ounces without previously laying or removing the dust. Watering may be dispensed with by using explosives (in the coal) with a detonation temperature not exceeding 1,500 degrees C., in charges of not more than 4 ounces, this being permissibly increased to 13½ ounces if covered with clay stemming to a depth of 8 inches

"There is nearly always a certain amount of coal dust left in holes bored in coal, the amount depending on the hardness of the coal, the inclination of the hole, and the care bestowed on cleaning it out. According to some tests carried out by the French Commission the conclusions were drawn that the contents of blasting cartridges may become mixed with coal dust in shot holes bored in coal and that miss-fires under these conditions may cause the deflagration of the mixture, in which case any firedamp present is certain to be ignited. This danger is also present to a smaller extent in the case of complete detonation, the carbon present increasing the temperature of detonation and producing carbon monoxide, thereby facilitating the ignition of firedamp. In view of the probability of accidents arising from this cause, the Commission recommend that shot holes bored in the standing coal should be carefully cleared of dust; that the practice of ramming the cartridges so hard as to break the envelopes and mix the contents with coal dust should be abandoned, and that the size of the detonators should be increased.

"The risk of causing an explosion by the use of permitted explosives is practically confined to the use of blown-out or improperly stemmed shots. Experiments made in Austria show that a vacuum resulting from a blown-out shot may amount to as much as ½ inch of mercury, which is equivalent to 8 pounds to 9 pounds to the square foot. This reduction of pressure creates an increase in the flow of firedamp in the ratio of 235 to 100, so that a blown-out shot may itself be the means of furnishing a considerable amount of gas that otherwise would not have escaped from the coal. A blown-out shot also, of course, produces an immense volume of flame, which, coming into contact with the coal dust on the roof, floor and sides of the road, is liable to raise and ignite it, and so bring about a disastrous explosion.

"Such safety as is at present obtainable appears to lie in entrusting the charging, stemming and firing of shots to selected men, insisting on the use of a sufficient length of proper stemming and of efficient detonators."

PEAT COAL.

A DESCRIPTION OF THE NEW EKENBERG PROCESS FOR THE MANUFACTURE OF PEAT FUEL BRIQUETTES.

Iron and Coal Trades Review.

REVIEWS in these columns of THE ENGINEERING MAGAZINE for December, 1907, and February, 1908, have already described the successful Frank-Caro process for the utilization of peat in gas producers with recovery of by-products and the Ziegler system of by-product coking. Attention was turned to the problem of the utilization of peat, first in by-product coke ovens, and then in gas producers when after a half-century of experiment it seemed impossible to devise a successful process for converting peat into a satisfactory commercial fuel for domestic and power-producing purposes. According to an article published in the *Iron and Coal Trades Review* for July 17, however,

the latter problem has been satisfactorily solved by Dr. Martin Ekenberg, whose process is described in the following abstract.

The cause of the failure of the many attempts made to produce peat in a form that would equal coal in utility lay in the difficulty of getting rid of the large quantity of water invariably contained in raw peat. The consistency of the material is such that only a small proportion of the water can be got rid of by mechanical means, and the cost of artificially drying a material containing normally about 87½ per cent. of water is prohibitive. The only alternative has been to allow the peat to dry in the air, but this apparently simple process has many drawbacks. The production is entirely dependent on climate and season, and the qualities of fuel produced also are influenced by these factors to a certain extent. The manual labor connected with air drying makes the apparently cheap process a very expensive one, and coal made from air-dried peat is dearer than ordinary coal with the additional disadvantage that, weight for weight, its bulk is four to five times as great. It appears, then, that the two requirements which must be satisfactorily fulfilled to bring the peat-fuel industry into such a position that it can supply fuel for general use are, first, that the process should render the manufacture independent of the weather, and, second, that the product should have a heating value approaching that of ordinary coal with an equally-high specific gravity. It is claimed that Dr. Ekenberg has discovered the means of overcoming the difficulties, and has evolved a process fulfilling the requirements mentioned.

"His process is based on the discovery that when wet peat is subjected to a temperature of over 150 degrees C. in a closed vessel it is charred, more or less, depending upon the temperature used, thereby losing its property of retaining the water, the bulk of which can then readily, and at a low cost, be pressed out by mechanical means.

"In charring air-dried peat, retorts heated from the outside, without the presence of water, have hitherto been used. As gases are bad conductors of heat, this charring is a time-consuming operation, and generally it is very difficult to get the peat in the middle of the retort charred without overcharring the peat near the walls. In the wet carbonising process, the large quantity of water serves as a heat-conducting medium, allowing a short and sharply defined charring with a uniform effect which corresponds to the temperature used. The charring is thorough, and every particle of peat is exposed to the heat. A further effect is that paraffin substances are liberated, which serve to bind the mass together in the subsequent process of briquetting, thus giving the product a proper consistency and making it impervious to rain or moisture. Great loss of tar and gaseous hydrocarbons cannot be avoided in the old charring process, but it is claimed that no such loss occurs in the wet process.

"Shortly described, the operations are as follows:—The wet peat is taken from the bog by any of the usual methods, and passed through a specially-constructed cutting machine, which reduces it to a homogeneous pulp. By means of specially designed pumps, it is then forced in a continuous stream through the carbonising oven, which is heated to a moderate temperature. Here the peat pulp is subjected to the requisite temperature and pressure. The oven is constructed on a recuperative principle, so that variation of the percentage of water in the peat is practically immaterial. The pressure maintained in the oven is about 200 to 320 pounds per square inch, and at the corresponding temperature a partial carbonisation takes place which, as before mentioned, has the effect of so altering the properties of the material that the water can be pressed out. All the valuable volatile constituents of the peat are retained in the product, thus making it a fuel equal to coal. It is a noticeable feature of this treatment that the original quality of the peat has little or no influence on the finished product, except in yield, so that the age or ripeness of the bog is immaterial. From the oven the wet carbonised pulp passes direct to a press, where the water is pressed out.

"After the carbonising and pressing operations are completed, the mass contains only 8 to 14 per cent. of the water originally absorbed in it. This water is evaporated by a final drying by means of the waste heat from the carbonising oven. The peat is then ready for briquetting, which process is carried out in the ordinary and well-known briquetting presses.

"The finished peat briquettes have a black glossy appearance. They have a heating value of 6,000 to 6,800 calories per kilogram (about 10,200 to 12,500 B.T.U. per pound), or very nearly equal to that of ordinary coal. The specific gravity of the briquettes is 1.32 to 1.35 and one hectolitre weighs 85 to 100 kilograms, subject to the shape of the briquettes. The weight of one hectolitre of ordinary coal is about 78 kilograms with an average specific gravity of 1.31. These figures appear to show that the above-mentioned requirements of good peat fuel are fulfilled by the briquettes of peat coal made by the 'Ekenberg' process.

"On burning, the peat briquettes retain their form until consumed, give a long clear flame, and are stated to have proved equal to coal in all instances where they have been tried. They possess the important advantage of containing practically no sulphur, which might injure metals with which the flame comes into contact. Submitted to dry distillation, a good-burning coal-gas evolves, and a hard coke suitable for metallurgical purposes is left.

"At a locomotive trial of the new fuel, it was found to be smokeless and without cinders, which specially meets one of the requirements for naval purposes. An interesting point is that the coal produced by the process is obtained in very much the same way as by Nature's own process, viz., that the substance is exposed to the influence of heat in the presence of water under pressure, ordinary coal having probably been produced from plants under very much the same conditions.

"The cost of production of peat coal by the 'wet carbonising' process will be 4s. to 7s. 3d. per ton, according to local conditions. To these figures the expenses for briquetting have to be added. On a basis of 12½ per cent. of the water in the raw peat being left in the peat coal, to be evaporated by surplus heat from the carbonising oven, the following estimate gives the total manufacturing cost of the briquettes at the factory:—

	s.	d.
Raw peat in the bog (including fuel used in the factory)	0	8
Wages for excavation and transport of the raw peat to the factory	2	0
Wages in the factory	2	3
Depreciation and maintenance of plant	2	6
Administration and sundry expenses	1	4
Total cost of briquettes per ton	8	9

"These figures will, it is believed, be reduced considerably, especially the wages for excavation, by using modern excavating machinery.

"It remains to be noted that an experimental plant for working the process has been installed at Stafsjö in Sweden, and has been in operation for some time. Based upon his experience in connection with the process, Mr. Alf. Larson, who superintended the Stafsjö plant during its construction, puts the total cost of a factory to produce 100 tons of briquettes per day at about £27,500."

MOTOR CABS IN PARIS

TECHNICAL NOTES ON THE CONDITIONS NECESSARY FOR THEIR SUCCESSFUL OPERATION.

L. Périssé—Société des Ingenieurs Civils de France.

A VERY comprehensive paper on the subject of motor cabs in Paris, read by M. L. Périssé before the Société des Ingenieurs Civils de France on April 3, is published in the *Mémoires* for March. This type of vehicle has come into such extensive use in the larger and more important cities of both Europe and America that the following technical notes from M. Périssé's paper on the conditions governing successful operation in Paris will be of interest.

After outlining the development of traffic and transit facilities in Paris, M. Périssé gives detailed statistics of the increase in the number of motor cabs

during the last ten years. In 1898 the first 22 cabs were placed in service and the number at the end of 1907 was 2,359, the greatest increase having taken place since 1904. The vehicles are of many different types and there is no standardization of tariffs, though several of the more powerful companies have established a rate of one-third franc per kilometre, equivalent to 10¾ cents per mile. The average number of fares per day is 8 to 9 and the average distance traveled is about 75 kilometres, of which 15 to 20 are unremunerative. The averages of horse cabs are 14 fares for 30 kilometres.

An important difference between horse and motor cabs lies in the fact that the operating cost of the former is practically independent of the distance travelled, while in the case of motor vehicles every additional kilometre means a relatively high charge to cover fuel, maintenance and depreciation expenses. The motor-cab industry depends for its success on the attitude of the public and will be a success only when the public becomes more accustomed to the use of the passenger automobile. The pressing need in Paris is a unification of tariffs, or the adoption of three fixed tariffs according to the type of motor used, four-cylinder, three- and two-cylinder, and single-cylinder vehicles corresponding to a degree of comfort and speed justifying a difference in rate.

The chief items of expense connected with the operation of motor cabs are those for maintenance and repair of tires, fuel and lubricants, repairs, and amortization. After a review of the various types of tires on the market, M. Périssé concludes that under present conditions the pneumatic tire is the only one which will give satisfactory service. For their proper maintenance two conditions must be fulfilled; the tire should be subjected to a rigid examination at frequent intervals and repairs should be made before an irremediable accident ends the tire's usefulness prematurely; and the mechanism of the car should be so designed as to make sudden jerks impossible. It is necessary that the operation of the motor should be such that the driver cannot make mistakes in handling the levers and it is desirable that the rapidity with which the motor is thrown in and out of gear should be susceptible of control by the foot. Brake bars could be improved so that a more gradual braking action could be obtained and the steering gear should be so designed that in braking the play of the wheels would be taken up almost automatically, thus preventing the abnormal wear of the tires of the forward wheels when an undulating motion of the wheels is permitted.

The speed and weight of the vehicle should also be limited. A maximum speed of 35 kilometres an hour should be sufficient for cabs operating only within the city limits and this limitation would contribute also to lessening the number of accidents. As to the limitation of weight it is necessary to consider that the vehicle must be rigid and that the maximum of comfort is incompatible with light weight. The use of air-cooled motors, a return to tubular frames or the use of the new aluminium frames are means of reducing the weight without loss of rigidity.

The question of fuel is an important one. A fuel not subject to duty should be used and alcohol, benzol, and a mixture of equal parts of these two are possible substitutes for gasoline. Alcohol will not come into general use until a stable level of price has been reached. Next to fuel, the question of the carburetter is of first importance. The motor should start instantaneously from the cold and should work economically through a wide range of conditions. M. Périssé believes that best results would be obtained with a carburetter permitting the driver to admit a supplementary supply of air. As to lubrication no system has as yet given entire satisfaction and many improvements must be introduced to do away with smoking and other inconveniences.

It is necessary to distinguish between two distinct classes of repairs, those due to normal wear of the machines and others due to accident. Repairs of the first class should be made annually in slack seasons. In repairing or replacing parts damaged by accident it is important that the period of idleness of

the vehicle should be reduced to a minimum. Manufacturers can assist materially by supplying interchangeable and duplicate parts.

According to M. Périssé, the future of the motor cab in Paris depends on the following conditions:

1. Distinction between the cab for city use and that for use in the suburbs or for short tours.

2. In the case of the city cab the weight should not exceed 1,000 to 1,100 kilometres with three passengers and driver, to secure greatest economy in tires and fuel. A tariff should be adopted close to that of horse-drawn vehicles.

3. Lower speeds and limitation of speed by the use of small motors.

4. The use of alcohol or benzol as fuel.

5. The encouragement of the adoption of special means of lowering wear and maintenance costs.

6. Establishment by cab companies of their own repair shops to diminish idle time.

7. The introduction of comfortable vehicles with four-cylinder motors for use outside Paris and the adoption of a tariff of one-half franc per kilometre for cabs of this class. The tariff of one-third franc is remunerative only under certain conditions and it would seem necessary that to give the cab companies reasonable security this should be raised to two-fifths franc.

RAIL CORRUGATION.

A THEORY BASED ON OBSERVATION OF THE GRINDING OF THE WHEEL FLANGE AGAINST THE RAIL HEAD AND THE EFFECT OF DUST.

C. A. Carus-Wilson — Tramways and Light Railways Association.

A NEW theory of the causes of the corrugation of tramway rails was added to the already-long list by Prof. C. A. Carus-Wilson at the meeting of the Tramways and Light Railways Association held at the Franco-British Exhibition on July 10. The theory propounded by Prof. Carus-Wilson was suggested to him by the fact that corrugations on grooved rails are very often accompanied by a cutting of the check of the rail immediately opposite. When rails and wheels are new there is generally about ¼-inch clearance between the flange and the check on both sides. But after a certain amount of wear has taken place the flange may bear against the check. Instances of check cut tires are very common. Prof. Carus-Wilson does not propose to examine the causes of this wear, but, taking into account the fact that check cutting generally accompanies corrugation, to discover the connection between the two. The following is an abstract of his paper.

In his investigations Prof. Carus-Wilson uses a model consisting of a small four-wheeled truck with brass wheels 2½ inches in diameter, placed 4¼ inches center to center. The two wheels on one side were keyed to the axles; those on the other were allowed to run loose. One wheel of the latter pair was arranged so that it might be coupled to the axle by means of a rigid or an elastic plate fitting into slots in the end of the axle and in a stud on the rim of the wheel. The truck ran on brass rails 3 1/16 inches wide and 3 9/16 inches apart. The track was so arranged as to permit the passage between the rails of a weight hung from a central support and distributed equally over the four wheels by means of an equaliser suspension.

When the truck was loaded with a weight of fourteen pounds, a rigid coupler inserted in the loose wheel, and the truck pushed from end to end of the track with the flange of the coupled wheel pressed hard against the rail, it was found that the length of track covered in three complete revolutions of the coupled wheel was about 2 per cent. longer than the distance covered when the truck was allowed to move freely without lateral pressure on the flange. Owing to this side pressure the flange bit the rail on a line of contact whose diameter was greater than that of the tread of the wheel; the wheel tended to

run on this line of contact and the tread was forced to skid on the head of the rail in consequence. The result was a motion combining roll and skid, the skidding, however, being continuous.

By this it appeared that when the flange is forced against the side of the rail the wheels are made to skid a certain percentage of the distance traveled. Investigations were then undertaken at Croydon to determine whether such skidding takes place on an actual tramway track. A four-wheeled car, weighing 7.8 tons and equipped with apparatus for counting the revolutions of the axles, was run over a stretch of straight and nearly level track, badly corrugated for the greater part of the distance. The diameter of the car wheels was carefully measured and a distance amounting to 1581 times the diameter of the wheel was carefully chained along the track. The car was run over the distance at constant speed, and the time and revolutions were carefully taken. Two trips were made each way with the track very dry, and two trips each way after a heavy rainstorm. The results of the tests are given in the following table:

	Condition of Track.	Mean Counter-Revolutions.	Skid in Counter-Revolutions.	Skid in per Cent. of Distance Covered.	Mean Speed, Miles per Hour.
Down trip...	Dry	1516	65	4.1	11.2
" " ...	Wet	1535	46	2.9	11.1
Up trip.....	Dry	1522	59	3.7	14.4
" "	Wet	1547	34	2.1	14

From these results it appeared that car wheels skid on a tramway track in the same way as they did in the model.

Further experiments were then undertaken with the model to determine in what way the skidding could produce corrugation. In order to get a definite amount of skid, independent of possible variations in the side pressure exerted, a metal fillet was inserted against one of the rails in such a way as to lift the keyed wheels off the rail and force them to roll on the outside of their flanges. When the loose wheel was fitted with a rigid coupler the motion of the coupled wheel was a roll and a skid, and that of the keyed wheel a roll and a slip, the skidding, however, remaining quite uniform and continuous. When an elastic coupler of the nature of a stiff spring was inserted in place of the rigid plate, it was found that the spring was bent, no matter in which direction the truck was pushed. This indicated a tendency to twist the coupled wheel relatively to the axle, the angle through which the spring was bent representing the torsion required to overcome the adhesion between the tread of the wheel and the rail.

It was evident, therefore, that when the flange of a car wheel grinds against the rail in such a way as to cause skidding the axle will be twisted until the turn is sufficient to make the tread of the mate wheel skid on the rail, the elastic twist of the axle representing the bending of the spring in the model. So far the skidding was quite continuous, and there was no indication of an intermittent action such as could produce corrugation. When, however, fine sand was sprinkled on the rails, the difference in behavior of the coupled wheel was at once apparent; instead of moving uniformly as before it advanced with a series of jerks at regular intervals.

"The action is as follows:—When the torque on the spring has increased to a certain amount, the force of adhesion is overcome, and the wheel skids, turning meanwhile about its own axis, so that the whole force of the skid is concentrated over a limited area on the rail surface. In skidding, the wheel grinds through the grit on the surface of the rail, and comes into contact with clean metal: there is thus a large and sudden reduction in the coefficient of friction, and the wheel flies back under the influence of the spring through a considerable angle. The result is that the subsequent motion of the wheel upon the rail will be a pure roll while the spring is being again deflected. When the limit of adhesion is reached, the wheel again skids, and the process is repeated, the motion thus consisting of alternate rolling and skidding. The addition of the grit has made the skid intermittent, whereas formerly it was continuous. When the surface of the rail is clean, there is no sudden breaking down of the adhesion which is required to make the skid intermittent. This effect is not due to the increased torsion on the spring

consequent on the increase in the coefficient of friction; for the same torsion can be obtained with a clean rail by increasing the weight, when the skid remains continuous. . . . . .

"The experiments on the model afford an explanation of the connection between check-cutting and corrugation. The flange of one of the two wheels on an axle grinds against the rail on a line of contact having a diameter greater than that of the tread, causing both wheels to skid. The skidding on the one side, where the flange is grinding, will be uniform, but on the other side, owing to the twist of the axle, the skidding will be intermittent, provided the rail surface be sufficiently rough, and the motion will be an alternate rolling and skidding. This explains why, as a rule, corrugations appear on one rail only: both wheels are skidding, but, owing to the twist of the axle, one skids uniformly and the other intermittently, the intermittent skidding taking place on the rail opposite to that where the flange is grinding. Observation shows that the rail opposite the corrugated rail is generally scored uniformly, though often with a slight wavy appearance which is caused by the sudden release of the twist on the axle affecting the motion of the non-corrugating wheel."

In tramway practice the gritty material necessary to produce corrugation is furnished by dust and particularly by the sand which is put on the rail. Prof. Carus-Wilson believes that the presence of sharp grit on the rail surface is a prime factor in the production of corrugation, and he notes several cases in which badly corrugated stretches of track are found in close proximity to supplies of hard sand. The other factor in producing corrugations, the side pressure of the flange on the rail, is caused on the straight by irregularities of gauge and level, which make the car lunge from side to side and bear over against one rail or the other. This accounts for the irregular distribution of corrugations along the track. On curves the centrifugal force tends to press the flanges outward. On curves of large radius the speed will be practically the same as on the straight, and the conditions under which corrugations may be produced will be similar, except that the pressure is constant and always in one direction. For this reason corrugations on large radius curves will appear on the outer rail, accompanied by cutting of the check of the inner rail. On curves of small radius the difference in length between the inner and outer rail gives rise to a skidding apart from that due to the grinding of the flange on the rail and the conditions of corrugation become very complex. As a rule, however, the speed on small radius curves is too low to admit of corrugations being formed.

While Prof. Carus-Wilson is convinced that corrugations are usually caused by the grinding of the flange on the rail, he admits that they may be produced in other ways. A similar action may be set up, if for any reason the wheel should be forced to run on its flange. This may happen at points and crossings where the rail is badly worn and the flange actually touches the bottom of the groove, or, more commonly, in cases where the groove is allowed to get full of dirt. Flange riding on a packed groove is responsible for some of the most perplexing vagaries of corrugation. Unless both grooves are packed to the same height and with materials of equal hardness, corrugations are bound to appear on the rail opposite to that in which the groove packing is the lower or softer.

"The investigations outlined above appear to show that the following conditions are necessary for the formation of corrugations on grooved rails: (1) As regards the track:—(*a*) Irregularities in gauge or level, (*b*) Curvature, or (*c*) A packed groove; (2) As regards the rails:—(*d*) Surface rough with sand or gritty dust; (3) As regards the rolling-stock:—(*e*) Wheels with check-cutting flanges; (4) As regards traffic:—(*f*) A critical speed.

"Corrugations cannot be formed unless conditions (1), (2), (3), and (4) are all present at the same time—that is, peculiar conditions must exist simultaneously in the track, the rails, the rolling-stock, and the speed, and the absence of any one of these conditions will prevent corrugations being formed."

THE ENGINEERING INDEX

THE KEYSTONE
IN THE ARCH OF APPLIED SCIENCE

The following pages form a descriptive index to the important articles of permanent value published currently in about two-hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

(1) The title of each article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,

(7) *We supply the articles themselves, if desired.*

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the principal journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Arches.

The Diminishing-Curve Masonry Arch (Le Arcate in Muratura a Monta ribassata). Carlo S. Rivera. Begins an exhaustive theoretical discussion. Ills. 2400 w. Serial, 1st part. Monit Tech—June 10, 1908. No. 93630 D.

Rigid Bow-string Arches (Etude des Arcs à Tirant rigide). C. Birault. A mathematical discussion of the effect of vertically applied loads and changes of temperature. Ills. 3000 w. Génie Civil—June 20, 1908. No. 93627 D.

A Note on the Calculation of Concrete and Reinforced-Concrete Hingeless Circular Arches and Vaults (Ein Beitrag zur Berechnung von Bögen und Gewölben mit kreisförmiger Achse ohne Gelenke in Beton und Eisenbeton). I. B. Bosch. Mathematical. Ills. Serial, 1st part. 3000 w. Deutsche Bau—June 13. 1908. No. 93648 D.

Bascule.

The Franklin Street Bascule Bridge, Michigan City, Indiana. Illustrated description of a single-leaf bascule recently built to replace a swing span of a deck

We supply copies of these articles. See page 982.

highway bridge. 1200 w. Eng Rec—July 25, 1908. No. 93919.

See also Steel, under BRIDGES.

Blackwell's Island.

See Testing Materials, under MEASUREMENT.

Compression Members.

See Testing Materials, under MEASUREMENT.

Drawbridges.

The Drawbridge Over the Libau Harbor Canal (Die Drehbrücke über den grossen Hafenkanal in Libau). Harold Hall. The two halves of the swing span give a total clear opening of about 217 feet. Ills. Serial, 1st part. 2700 w. Zeitschr d Ver Deutscher Ing—June 6, 1908. No. 93683 D.

End Launching.

See Steel, under BRIDGES.

Foundations.

Concrete Pile Foundations for a Paris Railway Bridge. Illustrates and describes the construction of a new bridge over the Seine, Asnieres, France. 1000 w. Eng News—July 23, 1908. No. 93944.

Raising.

Raising the Broadway Bridge, Boston. Illustrates and describes methods of carrying out difficult work without interrupting heavy navigation. 1200 w. Eng Rec—July 18, 1908. No. 93811.

Reinforced Concrete.

Methods and Some Costs of Constructing a Reinforced-Concrete Arch Bridge. John Harms. Illustrated description of this bridge and the method of construction, with itemized costs. 2500 w. Engng-Con—July 22, 1908. No. 93907.

Steel.

The Wrought Compressive Member for Bridge Trusses. H. E. Horton. Discusses the limitations and relation of parts forming a member; their design, specifications, etc. General discussion. Ills. 5500 w. Jour W Soc of Engrs—June, 1908. No. 94019 D.

Railway Bridges of Moderate Span. Conrad Gribble. Shows how modern bridges have been gradually evolved, and how the investigation of stresses in materials has brought about the evolution of the modern steel girder. Ills. 4500 w. Cassier's Mag—July, 1908. Serial, 1st part. No. 93443 B.

Viaduct Over Walney Channel at Barrow-in-Furness. Illustrated description of a recently completed bridge with a bascule span, and the method of construction. Plates. 5000 w. Engng—July 17, 1908. Serial, 1st part. No. 93982 A.

The Erection of Long Span Trusses by the End-Launching Method.—The French River Bridge, Canadian Pacific Ry. An illustrated account of the erection of this bridge by the method named. 2500 w. Eng News—July 23, 1908. No. 93942.

The Replacement of Steel Trusses in a Railway Bridge Over the Elbe, Near Magdebourg (Le Remplacement des Travées métalliques d'un Pont de Chemin de Fer sur l'Elbe, près de Magdebourg). A. Bidault des Chaumes. Illustrated description of the work. Plate. 1700 w. Génie Civil—June 6, 1908. No. 93622 D.

See also Raising, under BRIDGES.

Timber.

Highway Bridge Across the Kansas River at Fort Riley, Kansas, Capt. P. S. Bond. Describes a bridge erected by enlisted men of the U. S. Army, which is unique in design and construction. 3500 w. Eng Rec—July 11, 1908. Serial, 1st part. No. 93707.

Viaducts.

Progress on the Queens Approach Viaduct on the Blackwell's Island Bridge. Illustrated description of work in progress on this steel structure. 1200 w. Eng Rec—July 18, 1908. No. 93817.

The Stony Brook Glen Viaduct. Illustrates and describes a single-track plate-girder structure, said to be the highest bridge in the State of New York. 3000 w. Eng Rec—July 4, 1908. No. 93526.

CONSTRUCTION.

Beams.

On the Determination of the Bending Moments at the Points of Support of Continuous Beams. Prof. J. H. Smith. Gives a method that will enable one to obtain the bending-moment diagrams for all possible cases of continuous beams in which the load and cross-section vary, the supports are at any given levels, and the ends fixed at given inclinations. 1500 w. Engng—June 26, 1908. No. 93561 A.

See also Concrete, under MATERIALS OF CONSTRUCTION.

Boring.

Testing Diamond Drill Borings at the Site of the Olive Bridge Dam, Ashokan Reservoir. Illustrates and describes the apparatus used and method of testing. 1200 w. Eng Rec—July 4, 1908. No. 93528.

Contractors' Plants.

Contractor's Plant for the Sewage Purification Works of Washington, Pa. R. F. Proctor. General plan and description. 2000 w. Eng News—July 16, 1908. No. 93791.

Excavation.

Cost of Excavating Earth with an Electrically Equipped Shovel. Report of work in Canada with a Thew shovel, operated by electrical power. 700 w. Engng-Con—July 22, 1908. No. 93908.

Examples of High and Low Cost of Wheel Scraper Work, with Comments on

the Efficiency of Work Done. Gives two examples illustrating how work can cost much more than it should, and showing the need of good foremanship. 1300 w. Engng-Con—July 22, 1908. No. 93909.

Foundations.

Pneumatic Caisson Foundations for the Lighthouse at the Elbow of Cross Ledge, Delaware Bay. Describes the conditions and the method of carrying out the work. 2500 w. Eng Rec—July 25, 1908. No. 93917.

Reinforced Wall Foundations on Yielding Subsoil. Gunvald Aus. Illustrated description of steel beam reinforcement used successfully for massive buildings. 700 w. Eng News—July 2, 1908. No. 93482.

Piling.

Column Action in Piles. Editorial discussion of problems in marine piling, the possibility of buckling, considering two interesting failures of pile foundations. 2800 w. Eng News—July 2, 1908. No. 93486.

Steel Sheet Piling for Retaining Earth Under Spread Footings. Illustrates and describes work in connection with the reconstruction of the old Custom House building in New York City. 900 w. Eng Rec—July 4, 1908. No. 93524.

See also Foundations, under BRIDGES.

Reinforced Concrete.

Some Phases of the Building Situation in San Francisco. An interesting account of the changes in architecture introduced since the earthquake, and the conditions that have affected the construction. Ills. 4500 w. Eng Rec—July 18, 1908. No. 93814.

Reinforced Concrete in Engineering Structures. C. S. Meik. Read at meeting of the Inst. of Munic. & Co. Engrs. Describes some of the systems in use, discussing the designing, materials, and matters requiring care in various kinds of work. Ills. 7500 w. Surveyor—July 10, 1908. No. 93857 A.

The New Orleans Court House: A Reinforced Concrete Public Building. Illustrated description of a large public building of reinforced-concrete frame, with exterior of marble and tile. 1200 w. Eng News—July 2, 1908. No. 93481.

See also Tanks, under WATER SUPPLY; and Conduits, under ELECTRICAL ENGINEERING, TRANSMISSION.

Retaining Walls.

See Ferry Approach, under WATERWAYS AND HARBORS.

Roofs.

Analytical Design of Vaulted Roofs (Analytische Berechnung von Kuppelgewölben). O. Gottschalk. Discusses both spherical and conical types. Ills. 3300 w. Beton u Eisen—June 10, 1908. No. 93659 F.

Steel Buildings.

American Steel Frame Buildings Abroad. An illustrated account of the achievements of the United States Steel Products Export Co. 1800 w. Ir Age—July 16, 1908. No. 93773.

Tall-Building Construction in New York. C. H. Hughes. Illustrated descriptions of recent examples of business structures and their construction, equipment, etc. 4000 w. Cassier's Mag—July, 1908. No. 93447 B.

See Wind Bracing, under CONSTRUCTION.

Tall Buildings.

Limit of Height for Tall Buildings. Interesting illustrations and information concerning the limit under present restrictions of the Building Code of the City of New York. 1200 w. Sci Am—July 25, 1908. No. 93926.

Tunnel Lining.

Examples of Labor Saving Machinery and Methods for Placing Concrete Tunnel Lining. Shows a variety of such machinery and plant, designed under the direction of E. C. Williams. 1500 w. Engng-Con—July 1, 1908. No. 93577.

Tunnels.

The Cost of Driving an Earth Tunnel for a Railroad. Gives itemized costs of the work. 2000 w. Engng-Con—July 1, 1908. No. 93578.

Tunnel Driving at Low Cost. Walter H. Bunce. Brief account of the methods employed in driving the Chipeta adit at Ouray, Colo. 900 w. Min & Sci Pr—July 11, 1908. No. 93808.

The Tunnels of the Franklin & Clearfield Railroad. H. M. North. Illustrated outline of construction work on the L. S. & M. S. Ry. 1500 w. Transit, Univ of Iowa—Vol. XIII, 1908. No. 93764 N.

The Rotherhithe Tunnel. Editorial, describing this recently completed tunnel under the Thames, the thirteenth, and the largest that has been driven. 1500 w. Engng—June 19, 1908. No. 93430 A.

New York Tunnel Extension of the Pennsylvania Railroad System. William Couper. Gives the schedule of engineering organization for constructing this extension, and the personnel of the management. Map. 1500 w. Bul Am Inst of Min Engrs—July, 1908. No. 94025 C.

Wind Bracing.

Wind Bracing in Buildings. Arthur L. Bobbs. Brief paper on methods used, followed by discussion. 2500 w. Pro Engrs' Soc of W Penn—June, 1908. No. 93760 D.

A Theoretical Discussion of the Knee Brace Design of Wind Bracing in Steel

Frame Buildings. R. B. Woodworth. Ills. 2500 w. Pro Engrs' Soc of W Penn —June, 1908. No. 93761 D.

MATERIALS OF CONSTRUCTION.

Cement.

The Effect of Alkali on Portland Cement. Information from a paper by J. Y. Jewett, before the Am. Soc. for Test. Mats. 2300 w. Eng Rec—July 25, 1908. No. 93923.

Standards for Portland Cement. W. W. Maclay. Read before the Am. Soc. for Test. Materials. A plea for conservatism in standards, especially for the tensile strength. 2500 w. Cement Age—July, 1908. No. 93997.

The Influence of Fine Grinding on the Physical Properties of Portland Cement. Richard K. Meade. Read before the Am. Soc. for Test. Materials. Gives results of experiments made to determine the actual commercial value of fine grinding. 3000 w. Cement Age—July, 1908. No. 93996.

The Addition of Pozzolane to Hydraulic Cements for Use in Sea Water (Additions de Pouzzolanes aux Mortiers en Prise à l'Eau de Mer). H. Vetillart and R. Feret. A general discussion of their value in preventing decomposition. Ills. 4200 w. Ann d Ponts et Chaussées—1908—I. No. 93610 E + F.

See also Cement Testing, under MEASUREMENT.

Cement Paste.

A Cement Paste for Protecting Steelwork from Locomotive Gases. Reports concerning an efficient, durable and economical coating and the method of application. 900 w. Eng Rec—July 18, 1908. No. 93813.

Concrete.

Tests of Plain Concrete Beams at St. Louis. Richard L. Humphrey. A report of tests made at the laboratories of the U. S. Geol. Survey in St. Louis. 1500 w. Eng Rec—July 11, 1908. No. 93709.

The Strength of Concrete Beams. Richard L. Humphrey. Report of investigations made at the structural materials testing laboratories, giving results of tests of 108 beams. 11500 w. U S Geol Survey—Bul. 344. No. 93755 N.

Some Tests of Concrete Beams Under Oft Repeated Loading. H. C. Berry. Read before the Am. Soc. for Test. Mat. Illustrates and describes the apparatus used, and reports tests made. 2000 w. Eng Rec—July 25, 1908. No. 93918.

The Effect of Alkali Soils on Concrete. Reviews the preliminary report of investigations carried out by the Montana State Agricultural College, investigations by the U. S. Reclamation Service, and others. Also editorial. 4000 w. Eng News—July 23, 1908. No. 93948.

Sands: Their Relation to Mortar and Concrete. Henry S. Spackman and Robert W. Lesley. Shows that their strength is as dependent on the sand as the cement, the necessity of inspection and testing of the sand, and the desirability of standard specifications for and standard methods of testing. 2500 w. Cement Age—July, 1908. Serial, 1st part. No. 93995.

See also Stone, under MATERIALS OF CONSTRUCTION.

Crushed Stone.

Voids, Settlement and Weight of Crushed Stone. Ira O. Baker. Gives results of tests made under a variety of conditions. 5500 w. Univ of Ill, Bul 23—May 6, 1908. No. 93776 N.

Mortar.

See Concrete, under MATERIALS OF CONSTRUCTION.

Steel.

The Wasting of Iron. Thomas Holgate. A study of waste through rusting, corrosion and decay, giving examples from practical experience. 2500 w. Builder—July 4, 1908. Serial, 1st part. No. 93781 A.

Stone.

Shearing Values of Stone and Concrete. Henry H. Quimby. Read before the Am. Soc. for Test. Mat. Considers shearing tests and the manner of making them. 2000 w. Eng Rec—July 18, 1908. No. 93815.

Timber.

Southern Yellow Pine. Arthur J. Cox. The manufacture and supply for construction work is discussed. Ills. 3500 w. Transit, Univ of Iowa—Vol. XIII, 1908. No. 93768 N.

Timber Preservation.

The Economic Aspects of Wood Preservation for Structural Purposes. Carlile P. Winslow. Gives data of costs, results, and savings effected. 4000 w. Engineering Magazine—Aug., 1908. No. 94013 B.

See also Pavements, under MUNICIPAL.

MEASUREMENT.

Cement Testing.

A Rapid Method for Comparing the Liability of Hydraulic Cements to Decomposition by Sea Water (Une Méthode accélérée pour Comparer l'Aptitude des Liants hydrauliques à la Decomposition par l'Eau de Mer). R. Feret. Describes a method for use in the laboratory. 4500 w. Ann d Ponts et Chaussées—1908—I. No. 93609 E + F.

Hydrographic Surveying.

The Long Wire Drag or Sweep for

Subaqueous Charting. Describes methods used by the U. S. Geodetic and Coast Survey for determining shoals and rocks. 2000 w. Eng Rec—July 18, 1908. No. 93816.

Stream Gauging.

Recent Changes of Methods and Equipment in the Water Resources Work of the United States Geological Survey. John C. Hoyt. Illustrates and describes recent changes in instruments and methods used in stream gaging. 1000 w. Eng News—July 2, 1908. No. 93485.

Testing Materials.

A Ready Means of Making Compression Tests on Large Size Compression Members with Special Reference to the Blackwell's Island Bridge. A letter from Gustav Lindenthal referring to a method proposed by Col. Henry Flad for the St. Louis steel arch bridge in 1872. 500 w. Eng News—July 30, 1908. No. 94046.

See also Concrete, under MATERIALS OF CONSTRUCTION; and Fuel Testing, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

MUNICIPAL.

Drainage.

See Sewage Disposal, under MUNICIPAL.

Dunoon.

Municipal Engineering Works at Dunoon, with Special Reference to the Working of Mechanical Filters. James Andrew. Read at Scot. Dist. Meeting of Assn. of Munic. & Co. Engrs. Description and discussion. Ills. 12000 w. Surveyor—June 26, 1908. No. 93553 A.

Garbage Disposal.

City Refuse and Its Disposal. H. de B. Parsons. An illustrated article dealing with the disposal of New York City refuse. 2500 w. Sci Am Sup—July 4, 1908. No. 93490.

Utilization of Residuals from Refuse Destructors. H. Percy Boulnois. Discusses uses of destructor clinker, different kinds of metal in home refuse, etc. 2500 w. Surveyor—July 17, 1908. No. 93973 A.

The Chicago Underground Railway System of Refuse Disposal. Frank C. Perkins. Describes the disposal station and method of moving the material. 900 w. Munic Engng—July, 1908. No. 93763 C.

Pavements.

Creosoted Wood Block Paving. H. C. Innes. A short description of the preparation of the material and the construction of the pavement. 1400 w. Munic Engng—July, 1908. No. 93762 C.

Roads.

Road Making in Relation to Street Cleaning. H. Percy Boulnois. Read before the Inst. of Cleans. Supts. A general discussion of this subject, stating the requirements of an ideal road. 2500 w. Surveyor—July 10, 1908. No. 93858 A.

Engineering Problems in Road Construction. Joseph W. Hunter. An illustrated account of the work of the Penna. State Highway Department and the difficulties encountered. General discussion. 7000 w. Pro Engrs' Club of Phila—April, 1908. No. 94003 D.

The Acceptance of Stone for Use on Roads, Based on Standard Tests. R. S. Greenman. Read before the Am. Soc. for Test. Mat. Considers problems of road construction and the requirements to select suitable stone. 1700 w. Eng Rec—July 11, 1908. No. 93706.

New Methods of Road Maintenance (Neuere Bestrebungen auf dem Gebiete der Strassenpflege). Jakob Bacher. Discusses the changes made necessary by the advent of automobiles and various new methods and materials for road construction and maintenance. Ills. 3000 w. Oest Wochenschr f d Oeffent Baudienst—June 13, 1908. No. 93662 D.

Sewage Disposal.

Sewerage and Drainage of New Orleans. An illustrated general description. 1800 w. Munic Jour & Engr—July 1, 1908. No. 93497.

Sewage Disposal at Burslem. F. Bettany. Brief description of new works for treatment of domestic sewage. 1500 w. Surveyor—July 3, 1908. No. 93723 A.

Sewage Purification at Washington, Pa. R. Winthrop Pratt. Illustrated detailed description of a new plant for a manufacturing town near Pittsburg, costing about $100,000. 6500 w. Eng News—July 16, 1908. No. 93790.

Main Sewerage and Sewage Disposal. T. Aird Murray. Aims to describe the leading features of an up-to-date disposal plant, and the subject of sewerage. 2500 w. Can Engr—July 17, 1908. Serial, 1st part. No. 93797.

Hydrolytic Sewage Tanks. Illustrated description of the tanks and the theory of operation. 2500 w. Munic Jour & Engr—July 1, 1908. No. 93495.

The Travis Hydrolytic Sewage Tanks at Norwich, England. From a paper by Arthur E. Collins, recently read before the Inst. of Munic. & Co. Engrs., describing the principles on which the works have been based and their operation. 3500 w. Eng Rec—July 25, 1908. No. 93921.

The Hampton Doctrine in Relation to Sewage Purification. W. Owen Travis. An explanation and discussion of the Hampton doctrine, applying it to actual operation. 5000 w. Surveyor—July 10, 1908. No. 93859 A.

We supply copies of these articles. See page 982.

Studies of the Physiological Control of Sewage Filters, at New Britain, Conn. Milton W. Davenport. Describes the filtration plant and records the organisms which have been found in water more or less polluted, giving conclusions and suggestions. 2000 w. Eng News—July 30, 1908. No. 94043.

See also Purification, under WATER SUPPLY.

Sewage Sampling.

An Automatic Device for Sampling the Flow in Combined Sewers at Any Desired Dilution. G. S. Coleman. Illustrates and describes the device, explaining method of taking samples. 1000 w. Eng News—July 2, 1908. No. 93484.

Sewers.

The Harlem Creek Sewer and Its Steel Centering: St. Louis, Mo. Describes what is believed to be the largest concrete sewer in the United States. Ills. 2200 w. Eng News—July 30, 1908. No. 94047.

Sewerage of Queens Borough. Alberto Schreiner. Abstract of paper read before the Munic. Engrs. of City of N. Y. An explanation of conditions and the work in progress. Ills. 2500 w. Munic Jour & Engr—July 1, 1908. No. 93494.

WATER SUPPLY.

Baltimore.

Baltimore's Pressing Need of More Water. Map showing the present, proposed, and possible supply, with explanation of the proposed improvements. 3000 w. Mfrs' Rec—July 16, 1908. No. 93782.

Dams.

Planning the Execution of a Contract for a Dam, the Methods Used, Together with Some Notes and Comments on the Plant Needed and the Life of Such a Plant. Relates to the construction of the Cross River dam for the additional supply of New York City. 4500 w. Engng-Con—July 15, 1908. No. 93819.

The Great Roosevelt Irrigation Dam. Day Allen Willey. An illustrated description of this great undertaking which will provide water for irrigating more than a quarter of a million acres of arid land in Arizona. 1400 w. Sci Am—July 4, 1908. No. 93488.

See also Reservoirs, under WATER SUPPLY.

Filtration.

See Dunoon, under MUNICIPAL: and Oakland, Cal., and Springfield, Mass., under WATER SUPPLY.

Fire Protection.

Successful Test of New York's New High-Pressure Fire Service. An illustrated account of a test demonstrating the success of the system, with information relating to the plant. 1800 w. Sci Am—July 11, 1908. No. 93596.

Recent Developments in Fire Protection Devices. Gorham Dana. Discusses automatic sprinklers and their working, alarm service, fire doors, shutters, etc. Ills. 6000 w. Tech Qr—June, 1908. No. 93769 E.

Automatic Fire Protection. W. A. Neracher. Brief review of the history and development of automatic systems, describing the sprinkler equipments. Discussion. 6000 w. Pro Engrs' Soc of W Penn—July, 1908. No. 94024 D.

Irrigation.

The Nile Irrigation Question. C. O. Burge. Brief account of what has been done and is proposed in Egypt and the Soudan by means of irrigation. 2200 w. Eng Rec—July 18, 1908. No. 93810.

The Irrigation of Egypt and the Success of the Aswan Dam. Editorial on the official report for 1907, and remarks on other irrigation works in progress. 1000 w. Sci Am—July 4, 1908. No. 93487.

The Mexican National Irrigation Law. Arturo Reyes Temple. Explains the great need of irrigation in Mexico, and gives the law as passed by the National Congress. 1700 w. Eng Rec—July 25, 1908. No. 93922.

See also Dams, under WATER SUPPLY.

Oakland, Cal.

The Testing Station and Filter Plant Improvement of the People's Water Co., Oakland, Cal. W. W. De Berard and Langdon Pearse. Explains the conditions and describes the scheme for providing adequate water supply, illustrating the works named. 3500 w. Eng Rec—July 25, 1908. No. 93920.

Orifices.

Coefficients of Discharge Through Circular Orifices. Extracts from a paper describing experiments made in Australia, by H. J. I. Bilton, and the conclusions reached. 1500 w. Eng News—July 9, 1908. No. 93595.

Pipe Flow.

Loss of Pressure in the Transmission of Liquids and Gases (Der Druckhöhenverlust bei der Fortleitung tropfbarer und gasförmiger Flüssigkeiten). R. Biel. Derives a new general formula. Ills. Serial, 1st part. 2500 w. Zeitschr d Ver Deutscher Ing—June 27, 1908. No. 93688 D.

Pipe Lines.

The Design of Pipe Lines of Small Diameter (Calcul des Conduites d'Eau de petit Diamètre). M. Dariès. Discussion of the piping of buildings to secure the best results, giving tables showing piping discharges under various conditions and according to various formulæ. Rev de Mécan—June, 1908. No. 93612 E + F.

We supply copies of these articles. See page 982.

Pipe Tests.

Tests of Cast Iron and Reinforced Concrete Culvert Pipe. Arthur N. Talbot. Results of tests at the University of Illinois. Ills. 20000 w. Jour W Soc of Engrs—June, 1908. No. 94021 D.

Purification.

Ohio Water and Sewage Purification. R. Winthrop Pratt. Reports the results of investigating all the plants in the State. 2000 w. Munic Jour & Engr—July 1, 1908. No. 93496.

Ozone Water Treatment (Ueber Ozonewasserwerke). Dr. Gg. Erlwein. Illustrates and describes various systems of ozone purification treatment and gives the results of three years' operation of the Paderborn plant. 2000 w. Gesundheits-Ing—June 6, 1908. No. 93600 D.

Reservoirs.

The Santo Amaro Reservoir and Hydraulic-Fill Dam, Brazil. Thomas Berry. Illustrates and describes interesting features of construction. 4000 w. Eng Rec—July 4, 1908. No. 93522.

The Design and Construction of Impounding Reservoirs. William Watts. A summary of the writer's experience, including the construction of 18 reservoirs for the water supplies of large corporations, and also smaller ones. Also discussion. 4500 w. Surveyor—July 3, 1908. No. 93722 A.

The Vingeanne Reservoir (Le Réservoir de la Vingeanne). M. Jacquinot. Describes the construction of one of the large regulating reservoirs of the Marne-Saône canal. Ills. Plates. 11000 w. Ann d Ponts et Chaussées—1908—I. No. 93607 E + F.

Springfield, Mass.

The Little River Water Supply for Springfield, Mass. Illustrated description of the filter plant, sand washers, and other features. 3500 w. Eng Rec—July 11, 1908. No. 93705.

Tanks.

Layout and Construction of a Large Water Tank. Illustrated detailed description of tower and tank erected at Louisville, Ky. 1500 w. Boiler Maker—July, 1908. No. 93466.

Reinforced Concrete Tanks. L. Mess. Illustrates and describes interesting structures in Europe and America. 800 w. Min & Sci Pr—July 25, 1908. No. 94049.

Testing Plants.

See Oakland, Cal., under WATER SUPPLY.

Water Works.

A Tropical Water-Works. Henry A. Young. Describes conditions in Cuba from a water-works standpoint, and the works for the city of Camagüey. 2500 w. Eng Rec—July 4, 1908. No. 93525.

Water Service Plant for the Delaware Water Company at Christiania Creek. Illustrated description of a new pumping station and water service plant which will supply the P. B. & W. Ry. 1200 w. R R Age Gaz—July 24, 1908. No. 93939.

Wells.

Wells and Boreholes for Town Water Supply. H. Ashton Hill. Read before the Assn. of Water Engrs. Discusses the legal right to take underground water, the analytical conditions, relative merits of wells and boreholes, construction, etc. General discussion. 8500 w. Surveyor—July 17, 1908. No. 93972 A.

WATERWAYS AND HARBORS.

Canals.

The Widening of the Suez Canal. An illustrated account of work in progress and the difficulties encountered. 1700 w. Sci Am—July 25, 1908. No. 93927.

The Newark Ship Canal. Discusses the project for making Newark, N. J., an important port, outlining the character of the problem. 3000 w. Eng Rec—July 4, 1908. No. 93523.

The Break in the Cornwall, Ont., Canal and the Consequent Drawbridge Collapse. An illustrated account of the collapse and repairs. 3000 w. Eng News—July 9, 1908. No. 93593.

See also Columbia River, and Newark, N. J., under WATERWAYS AND HARBORS.

Columbia River.

U. S. Improvements of the Columbia River, Oregon and Washington. W. P. Hardesty. Describes the jetty at the mouth of the river, and the Celilo-Dalles canal, around rapids in the river. Ills. 9000 w. Eng News—July 30, 1908. No. 94042.

Docks.

Royal Edward Dock at Avonmouth, Bristol. Gives plan and illustrated detailed description of this great engineering project, costing 2½ millions sterling. 3000 w. Engng—June 26, 1908. Serial, 1st part. No. 93565 A.

See also Newark, N. J., under WATERWAYS AND HARBORS.

Ferry Approach.

The St. George Ferry Approach Improvements, New York City. An illustrated account of improvements on Staten Island, to cost about $1,000,000. The construction of a reinforced-concrete retaining wall is described. 4500 w. Eng Rec—July 11, 1908. No. 93704.

Floods.

Flood Damage at the Great Falls Smelter, Montana. F. S. Shewell. An illustrated account of recent floods in the valleys of the Missouri and Sun rivers. 600 w. Min & Sci Pr—July 11, 1908. No. 93807.

French Ports.

The Transformation and Autonomy of the Great French Ports (Les grands Ports français, leur Transformation et leur Autonomie). Georges Hersent. Discusses the growth in the size of vessels, the accommodations demanded in harbors, the condition of French ports, etc. Ills. 20000 w. Mem Soc Ing Civ de France—March, 1908. No. 93605 G.

Georgian Bay Canal.

The Official Report on the Georgian Bay Ship Canal. A summary of the report as published in the Ottawa *Evening Journal* of July 6. 3000 w. Eng News—July 16, 1908. No. 93793.

Jetties.

See Columbia Rivers, under WATERWAYS AND HARBORS.

Lighthouses.

See Foundations, under CONSTRUCTION.

Lock Gates.

The Lock Gates at the Charles River Dam, Boston and Cambridge, Mass. Edward C. Sherman. Illustrated description of the type adopted, and the methods of supporting and moving them. 3000 w. Eng News—July 9, 1908. No. 93592.

Mechanical Locks.

The Transverse Inclined Plane Type of Ship Lift (Das Schiffshebewerk mit Schraubenführung auf schiefer Ebene mit Querneigung). Fr. Jebens. A general discussion of the design of this type. Ills. 4000 w. Glasers Ann—June 15, 1908. No. 93657 D.

Newark, N. J.

A Proposed Land Reclamation and Dock Scheme for Newark, N. J. Plan, and information concerning the proposed canal harbor and municipal docks, with reclamation of a large area of meadow land. 2500 w. Eng News—July 23, 1908. No. 93947.

Ohio River.

The Ohio River. J. W. Arras. A brief description of its principal navigation improvements, with mention of some of its characteristics. Ills. Discussion. 11000 w. Pro Engrs' Soc of W Penn—June, 1908. No. 93759 D.

Panama Canal.

Progress at Panama. The present number is mainly a review of the history and outline of the project, with maps and sections. 5000 w. Engr, Lond—July 3, 1908. Serial, 1st part. No. 93733 A.

River Improvement.

River Canalization. C. E. Gordon. An outline of the principal features requiring consideration in this work. 4000 w. Transit, Univ of Iowa—Vol. XIII, 1908. No. 93765 N.

Sea Walls.

An Extensive Sea Wall at Coronado Beach, California. Illustrated description of the construction of a loose-rock-fill wall to protect the fore-shore. 2000 w. Eng Rec—July 18, 1908. No. 93812.

MISCELLANY.

Roebling.

A Monument to a Famous Engineer. Illustration, with an interesting review of the life of John A. Roebling, as given by Henry D. Estabrook in address at the unveiling of the statue at Trenton, N. J. 3000 w. Eng News—July 16, 1908. No. 93789.

ELECTRICAL ENGINEERING

COMMUNICATION.

Radio-Telegraphy.

The Resistance Equivalent of Electromagnetic Radiation from a Linear Oscillator. Oscar C. Roos. Analytical study. 4000 w. Elec Rev, N Y—July 4, 1908. No. 93537.

The Ducretet Radio-Telegraphic Apparatus (Communication de E. Ducretet, sur ses Appareils de Télègraphie sans Fils). An illustrated detailed description. 2800 w. Bul Soc d'Encour—May, 1908. No. 93614 G.

See also A. C. Dynamos, under DYNAMOS AND MOTORS.

Telephone Cables.

Notes on Recent Submarine Telephone Cables (Neuere Beobachtungen an unterseeischen Fernsprechkabeln). F. Breisig. Describes two cables recently laid between Denmark and the German coast and shows their importance as marking progress in this field. Ills. 2000 w. Elektrotech Zeitschr—June 11, 1908. No. 93691 D.

Tele-Photography.

Korn's New Telephotographic System. An illustrated account of the method of sending pictures by wire from Paris to London. 1800 w. Sci Am Sup—July 4, 1908. Serial, 1st part. No. 93491.

DISTRIBUTION.

Circuit Breakers.

Fuses and Automatic Circuit-Breakers. W. B. Kouwenhoven. Explains their use, describing types. 2000 w. Ry & Loc Engng—July, 1908. No. 93512 C.

Fuses.

See Circuit Breakers, under DISTRIBUTION.

We supply copies of these articles. See page 982.

Insulation.

Rubber Insulation. Describes the preparation, manufacture and application of the material. 1400 w. Elec Wld—July 25, 1908. No. 93914.

Receiving Stations.

Receiving Stations Operated from High-Tension Transmission Lines. Considers the suitable equipment for such stations. 4000 w. Elec Age—July, 1908. No. 93472.

Wire Heating.

Heating of Conductors by Electric Currents. Sydney F. Walker. Gives formulæ for the heating effect, with notes. 700 w. Eng & Min Jour—July 25, 1908. No. 93955.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Portable Type of High-Frequency Alternator. R. A. Fessenden. Illustrates and describes a high-frequency alternator driven by a small steam turbine for use in wireless telegraphy. 3000 w. Elect'n, Lond—July 3, 1908. No. 93727 A.

Alternators in Parallel. Morgan Brooks. Considers the influence and relative importance of the circumstances controlling the successful operation. Discussion. 7000 w. Jour W Soc of Engrs—June, 1908. No. 94022 D.

Practical and Theoretical Notes on the Parallel Operation of A. C. Machines (Praktisches und Theoretisches über den Parallelbetrieb von Drehstrommaschinen). O. Weisshaar. The first part is mathematical and theoretical. Ills. Serial, 1st part. 4500 w. Elektrotech u Maschinenbau—June 28, 1908. No. 93680 D.

A. C. Motors.

Alternating-Current Motors and Lamps for Industrial Plants. Warren H. Miller. An explanation of the possibilities of the alternating-current system. 3500 w. Elec Wld—July 4, 1908. No. 93477.

Armatures.

See Windings, under DYNAMOS AND MOTORS.

Commutation.

Demonstration Apparatus for Illustrating Commutation. Harrison W. Smith. Illustrated description of two pieces of apparatus used at the Mass. Inst. of Tech. 1200 w. Tech Qr—June, 1908. No. 93770 E.

D. C. Dynamos.

The Operation of Electrical Machinery. Norman G. Meade. Gives a classification of direct-current generators, explaining how connections are made, the effects of residual magnetism, etc. Ills. 2000 w. Power—July 21, 1908. Serial, 1st part. No. 93845.

Induction Motors.

The Induction Motor—Its Characteristics in Their Relation to Industrial Applications. A. M. Dudley. Discusses performance curves and typical applications. 7500 w. Elec Jour—July, 1908. No. 93756.

The Exact Circular Current-Locus of the Induction Motor. K. J. Laurell. Explains an interesting method of determining the correct locus of the primary current. Also editorial. 2000 w. Elec Wld—July 11, 1908. No. 93590.

Polyphase Induction Motors: The Choice of Type. G. Stevenson. Abstract of paper read before the Glasgow Sec. of Inst. of Elec. Engrs. Describes the characteristics of squirrel-cage and slip-ring induction motors, showing that in most cases the former can be satisfactorily installed. 3500 w. Elect'n, Lond—June 19, 1908. No. 93419 A.

Standards.

A Comparison of American and German Standards for Electrical Machinery (Vergleich der amerikanischen und deutschen Maschinennormalien). Georg Stern. Discusses principally dynamos. 3000 w. Elektrotech Zeitschr—June 4, 1908. No. 93689 D.

Windings.

Relation Between Number of Turns and Resistance of Magnet Spool Windings. Paul M. Rainey. The method described treats only of magnets having circular cores and conductors of circular cross-section. 1200 w. Elec Wld—July 11, 1908. No. 93591.

Wave Winding for Direct-Current Armatures. George T. Hanchett. Gives a rule devised by the writer explaining its application. 600 w. Elec Wld—July 4, 1908. No. 93479.

ELECTRO-CHEMISTRY.

Cells.

On the Free Energy of Nickel Chloride. M. de Kay Thompson and M. W. Sage. An investigation and measurement of the electromotive force of a nickel-chloride cell. 2500 w. Tech Qr—June, 1908. No. 93771 E.

Electro-Metallurgy.

Progress in the Application of Large Electric Furnaces to the Production of Calcium Carbide and High-Percentage Ferro-Silicon (Ueber die Fortschritte in der Verwendung grosser elektrischer Oefen zur Fabrikation von Kalziumkarbid und hochprozentigem Ferrosilizium). Walter Conrad. A review of the technology of these processes. Ills. Serial, 1st part. 2800 w. Stahl u Eisen—June 3, 1908. No. 93633 D.

Electro-Plating.

Buck's Method of Producing an Extra

We supply copies of these articles. See page 982.

Heavy Deposit of Silver Upon the Wearing Parts of Flat Ware. Illustrated detailed description. 900 w. Brass Wld—July, 1908. No. 93848.

A New Process of Producing Dead Black Nickel Deposits, and the Method of Using Black Nickel Solutions. Describes the various operations, explaining difficulties and their causes. 2500 w. Brass Wld—July, 1908. No. 93847.

ELECTRO-PHYSICS.

Radio-Activity.

On the Emission of Electricity from the Induced Activity of Radium. William Duane. Reports investigations made in the radium laboratory of the University of Paris, and states conclusions. 4000 w. Am Jour of Sci—July, 1908. No. 93449 D.

GENERATING STATIONS.

Accumulators.

"A. C." Accumulator Sub-Stations and the Use of Accumulators for Peak Loads. A. M. Taylor. Abstract of a paper read before the Incor. Munic. Elec. Assn. Considers the possibility of putting in accumulators instead of generating plant to deal with the peak load of a station as the output increases. Discussion. 8000 w. Elect'n, Lond—July 10, 1908. No. 93865 A.

Central Stations.

Equipment of a Modern Central Station. Osborne Monnett. Illustrated description of the apparatus and operating features of the steam hydro-electric plant of the People's Power Company, Moline, Ills. 2500 w. Power—July 28, 1908. No. 93989.

The Reconstruction of an Electric Lighting Scheme with Observations on the Working of a Combined Steam and Water Power Plant. C. M. Shaw. Abstract of a paper read before the Incor. Munic. Elec. Assn. Describes the Worcester electricity supply scheme. 1800 w. Elect'n, Lond—July 3, 1908. No. 93726 A.

Chignecto Electric Plant. H. Mortimer Lamb, and W. J. B. Drew. Describes a steam power plant at the mouth of a coal mine to deliver electric power 6½ miles to the city of Amherst, N. S. 2000 w. Mines & Min—July, 1908. No. 93518 C.

The Castelnuovo-Valdarno Power Station of the Società Mineraria ed Elettrica del Valdarno (Das Kraftwerk Castelnuovo-Valdarno der Società Mineraria ed Elettrica del Valdarno). L. Pasching. Illustrates and describes a large plant situated at a lignite mine and supplying power to Florence, Siena, and other cities of Northern Italy. Serial, 1st part. 2000 w. Elektrotech u Maschinenbau—June 14, 1908. No. 93678 D.

See also Gas Power Plants, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Design.

Some Considerations on the Design of a Generating Station. H. Richardson. Slightly abbreviated paper read before the Incor. Munic. Elec. Assn. Mainly discusses a steam turbo-alternator system with extra-high-pressure alternating supply. 5500 w. Elect'n, Lond—July 3, 1908. No. 93728 A.

Economics.

Method of Investigating the Cost of Producing Electrical Energy. Edwin D. Dreyfus. Outlines the procedure to be followed by the consideration of a concrete case. 1500 w. Elec Wld—July 4, 1908. No. 93478.

Hydro-Electric.

The Wreck of the Cazadero Hydro-Electric Power Plant on the Clackmas River, near Portland, Ore. An authentic account of the accident, though not official. 800 w. Eng News—July 23, 1908. No. 93949.

Hydraulic Power Development by the Town of Kenora. Illustrated description of a new hydro-electric plant on the Winnipeg River, Ontario. 2500 w. Eng Rec—July 18, 1908. No. 93809.

Water Power for Iron Mining. Thomas W. Orbison and Frank H. Armstrong. Illustrated description of the hydro-electric plant of the Penn Iron Mining Co., at Vulcan, Mich. 3500 w. Ir Age—July 16, 1908. No. 93774.

The Brusio Power Plant, Campocologno (Die "Kraftwerk Brusio" in Campocologno). A profusely illustrated description of this large plant. Serial, 1st part. 2500 w. Die Turbine—June 5, 1908. No. 93670 D.

The Uppenborn Power Plant (Das Uppenbornkraftwerk). S. Meyer, H. Nietz, and K. Dantscher. A very thorough illustrated description of this large plant on the Isar which supplies power to Munich. Serial, 1st part. 2000 w. Elek Kraft u Bahnen—June 4, 1908. No. 93930 D.

Switchgear.

The Reyrolle Extra High-Tension Switchgear. Illustrated detailed description of switchgear of the iron-clad solid system. 2000 w. Elec Engr, Lond—June 26, 1908. Serial, 1st part. No. 93554 A.

Switching Apparatus and Its Practical Operation in Large Hydro-Electric Stations. Frank E. Conrad. An account of the design and operation of what has proved to be a simple and efficient switching apparatus and its practical operation. 3000 w. Elec Wld—July 25, 1908. No. 93913.

We supply copies of these articles. See page 982.

LIGHTING.

Alternating Current.

See A. C. Motors, under DYNAMOS AND MOTORS.

Arc Lamps.

Recent Developments in Electric Lamps. Maurice Solomon. A general survey of the present position and prospects in both incandescent and arc lamps. 4000 w. Nature—June 25, 1908. No. 93549 A.

Government Control.

State Regulation of Lighting Enterprises. H. L. Doherty. An address at the meeting of the Wisconsin Gas Assn. 10500 w. Am Gas Light Jour—July 20, 1908. No. 93796.

Hygiene.

A Study of the Principal Sources of Light from the Point of View of Eye Hygiene (Etude des principales Sources de Lumière au Point de Vue de l'Hygiène de l'Oeil). André Broca and F. Laporte. Includes incandescent arc, and mercury-vapor lamps. Ills. 9500 w. Bul Soc Int d'Elecns—June, 1908. No. 93611 F.

Illumination.

The Lighting of the Washington Union Station, Washington, D. C. Illustrated description of methods employed. 2500 w. Eng News—July 30, 1908. No. 94044.

Electrical Contractors' Opportunities in the Illuminating Field. George Loring. Abstract of a paper read before the Nat. Elec. Contr. Assn. Gives suggestions for the lighting of houses and stores, and matters related. Ills. 3500 w. Elec Rev, N Y—July 25, 1908. No. 93911.

Incandescent Lamps.

Tungsten Lamp Fallacies. H. Thurston Owens. Discusses the comparative cost of tungsten and inverted mantle gas lamps. Ills. 1500 w. Am Gas Lgt Jour—July 20, 1908. No. 93795.

The Tungsten Lamp. E. F. Tweedy. Briefly describes the more important methods of manufacturing a lamp filament from the metal tungsten and its electrical and physical properties. 4000 w. Cent Sta—July, 1908. No. 93739.

The Coming Development of the One-Watt Lamp and Electric Lighting (Beitrag zur Klärung der Frage betreffend die künftige Entwicklung der einwattigen Lampe und der elektrischen Beleuchtung). H. Remané. An economic discussion of high-efficiency lamps. 3500 w. Elektrotech Zeitschr—June 11, 1908. No. 93690 D.

See also Arc Lamps, under LIGHTING.

Photometry.

A Selenium Photometer. Describes an ingenious photometer patented by William J. Hammer, in which the sensitivity of selenium to light is practically applied. Ills. 1200 w. Sci Am—July 18, 1908. No. 93799.

MEASUREMENT.

Cable Testing.

The Testing of High-Tension Cables. C. Feldmann and J. Herzog. Abstract translation from *Elek. Zeit.* Discusses the advantages of grading the insulation of cables. In testing, prolonged application of excessive voltage is considered harmful. 1500 w. Elect'n, Lond—July 17, 1908. No. 93967 A.

Capacity.

On Some Methods of Measuring Capacity with Alternating Currents of Complex Wave Form. Robert Beattie. Points out the error in the "direct" method of measuring capacity by alternating current, and describes how this may be overcome. 2800 w. Elect'n, Lond—July 17, 1908. No. 93968 A.

Dynamo Testing.

The Determination of the Efficiency of Electric Machines (Sulla Determinazione del Rendimento delle Machine elettriche). Salvatore Spera. Outlines a method of determining the heat and leakage losses. Ills. 3000 w. L'Indus—June 14, 1908. No. 93629 D.

Galvanometers.

The Duddell Thermo-Galvanometer. A. Frederick Collins. Illustrated description of a device for measuring extremely small currents. 1000 w. Sci Am Sup—July 18, 1908. No. 93802.

Laboratories.

The Work and Equipment of a Testing and Standardizing Department. H. A. Ratcliff. Abstract of a paper read before the Incor. Munic. Elec. Assn. Notes on various features of practical interest. 2500 w. Prac Engr—July 3, 1908. Serial, 1st part. No. 93720 A.

Meters.

The Intermediate Resistance Between Commutator and Brushes in D. C. Ampere-Hour Meters and Recent Types of the Allgemeine Elektricitäts-Gesellschaft (Ueber den Uebergangswiderstand zwischen Kommutator und Bürsten bei Amperestundenzählern für Gleichstrom und die Neukonstruktionen der Allgemeinen Elektricitäts-Gesellschaft). Ills. 2400 w. Elektrotech Zeitschr—June 18, 1908. No. 93694 D.

TRANSMISSION.

Cables.

Notes Upon Mining Cables. J. H. C. Brooking. Discusses the requirements for mining cables, their protection, etc., and illustrates and describes cables and cable accessories for mines. 6500 w. Elect'n, Lond—July 10, 1908. No. 93875 A.

We supply copies of these articles. See page 982.

Conduits.

Reinforced-Concrete Conduits for Electric Cables; Long Island R. R. Frederick Aueryansen. Brief illustrated description of unusual conduit construction recently built in the new North Shore Freight Yard at Long Island City. 800 w. Eng News—July 3, 1908. No. 93943.

Excess Voltages.

The Cause, Effect and Control of Excess Voltages (Ursache, Wirkung und Bekämpfung von Ueberspannungen). C. Feldmann. Considers excess voltages to arise, in the main, from five types of oscillations, and discusses each. Ills. Serial, 1st part. 3600 w. Elektrotech Zeitschr—June 18, 1908. No. 93693 D.

Line Design.

Determining the Sizes of Alternating Current Line Wires. N. A. Carle. Gives charts and explanation of their use. 1200 w. Power—July 28, 1908. No. 93991.

Long-Distance Electric Transmission of Power. L. S. Bruner. Considers the design and location of the line, method of turning angles, etc., as used on the lines of the Niagara, Lockport, and Ontario Power Co. 3000 w. Pro Engrs' Club of Phila—April, 1908. No. 94006 D.

A Graphical Method for the Design of Three-Phase Transmission Lines (Método gráfico para el Cálculo de las Líneas de Transporte de Energía Eléctrica por Corrientes trifásicas). Enrique Campdera. A complete theoretical discussion. Ills. 5500 w. Rev Tech Indus—May, 1908. No. 93631 D.

The Various Methods of Designing Electrical Transmission Networks and Their Combinations (Ueber die verschiedenen Methoden zur Berechnung elektrischer Leitungsnetze und ihre Combinationen). G. Mattausch. Discusses the methods of Herzog, Coltri, Teichmüller, Frick and Kenelly. Ills. Serial, 1st part. 1400 w. Elektrotech Rundschau—June 19, 1908. No. 93676 D.

Rotary Converters.

The Voltage Regulation of Rotary Converters. 2000 w. Elec Rev, Lond—June 26, 1908. No. 93556 A.

Substations.

The Central Station Distributing System. H. B. Gear and P. F. Williams. Describes transmission and conversion systems, referring particularly to the location and design of substations. 4000 w. Elec Age—July, 1908. No. 93471.

See also Accumulators, under GENERATING STATIONS.

Transformers.

What Is the Ratio of a Transformer? Morton G. Lloyd. A criticism of the loose way in which the term "ratio" is used. 1000 w. Elec Wld—July 11, 1908. No. 93589.

Parallel Operation of Transformers. E. G. Reed. Discusses the distribution of the load current and the satisfactory parallel operation. 2500 w. Elec Wld—July 18, 1908. No. 93778.

Voltage Regulation.

Applications of the Thury Regulator (Applications du Regulateur Thury). J. A. Montpellier. Outlines its principal applications in the regulation of voltage of direct and alternating current generators. Ills. Serial, 1st part. 1200 w. L'Elecn—June 6, 1908. No. 93621 D.

MISCELLANY.

A. C. Waves.

Wave Form Analysis. P. M. Lincoln. A description of the Fischer-Hinnen method and its adaptation, with editorial comment. 3000 w. Elec Jour—July, 1908. No. 93757.

Farm Work.

The Equipment of Farms and Country Houses with Electricity. Putnam A. Bates. A résumé of what has been accomplished in applying electricity for lighting and power. Ills. 6000 w. Jour Fr Inst—July, 1908. No. 93998 D.

Resistances.

The Design of a Continuously Adjustable Resistance. J. T. Morris, R. Milward Ellis, and F. Stroude. Describes the various arrangements tried, the difficulties met, and the arrangement finally adopted. Ills. 2000 w. Elect'n, Lond—June 26, 1908. No. 93557 A.

INDUSTRIAL ECONOMY

Cost Systems.

Obtaining Actual Knowledge of the Costs of Production. This fourth article of a series discusses the use and abuse of mechanical aids in cost finding. 1800 w. Engineering Magazine—Aug., 1908. No. 94017 B.

Accounting and Cost Systems (Kalkulations- und Selbstkostenwesen). H. Meltzer. The first part discusses the importance and general principles of systematic accountancy. Forms. Serial, 1st part. 5500 w. Zeitschr d Ver Deutscher Ing—June 20, 1908. No. 93685 D.

See also Management, under INDUSTRIAL ECONOMY.

We supply copies of these articles. See page 982.

Education.

A Justification of the Technical School. Stanley G. Harwood. A reply to the paper by Frank Foster, on "The Un-Academic Side of Engineering." 2000 w. Ry & Engng Rev—July 25, 1908. No. 93962.

Two Years of the Coöperative Engineering Courses at the University of Cincinnati. Herman Schneider. Read before the Soc for Pro of Engng. Ed. Also editorial. Describes the system inaugurated in Cincinnati and its working. 5800 w. Eng News—July 9, 1908. No. 93594.

Labor.

Industrial Politics in England. Discusses the labor movement. 3500 w. Ir Age—July 16, 1908. No. 93775.

Japanese Factory Hands and Labor Conditions. M. Kawara. A brief review of changes due to the introduction of western ideas. 1200 w. Engineering Magazine—Aug., 1908. No. 94018 B.

Management.

The General Principles of Cost Accounting. Oscar E. Perrigo. Tenth of a series of articles on shop management and cost keeping. 5500 w. Ir Trd Rev—July 2, 1908. No. 93513.

Efficiency as a Basis for Operation and Wages. Harrington Emerson. This second article of a series discusses national efficiencies; their tendencies and influence. 5500 w. Engineering Magazine—Aug., 1908. No. 94010 B.

Patents.

Some Features of the German Patent Laws. Henry E. Schmidt. Facts relating to German patent and trade-mark legislation. 1500 w. Am Mach—Vol. 31, No. 29. No. 93788.

Production Census.

The Census of Production. An account of the steps taken by the United Kingdom, British Colonies and the United States to ascertain the extent of their own manufacturing industries. 2000 w. Engr, Lond—June 26, 1908. Serial, 1st part. No. 93718 A.

Stores Keeping.

Foundry Warehouse Methods. F. C. Everitt. Read before the Am. Found. Assn. Considers the arrangement of floors and a practical system for keeping records of stock and shipments. 1500 w. Foundry—July, 1908. No. 93572.

See also same title, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Sweden.

Mining and Industrial Progress in Sweden. John Geo. Leigh. This second article deals chiefly with the character and equipment of the leading industrial works. Ills. 6500 w. Engineering Magazine—Aug., 1908. No. 94012 B.

Wages.

The Various Plans for Payment of Wages. Harrington Emerson. A discussion of Forrest E. Cardullo's article on the system of diminishing and increasing premiums for the purpose of increasing the efficiency of employees. 3500 w. Ir Trd Rev—July 23, 1908. No. 93933.

MARINE AND NAVAL ENGINEERING

Ash Ejectors.

Schäffer & Budenberg's Patent Automatic Ash Ejector. Illustrates and describes this appliance for removing ashes from the stokeholds of steamships at sea, explaining its advantages. 1300 w. Mech Engr—July 3, 1908. No. 93725 A.

Barges.

Steam-Winch Coaling-Barge. Illustrated description of a barge constructed by Thomas White. 600 w. Engng—June 26, 1908. No. 93564 A.

Battleships.

U. S. S. New Hampshire. William Ashley Leavitt, Jr. Illustrated description and report of official trials. 13000 w. Jour Am Soc of Nav Engrs—May, 1908. No. 93999 H.

Progress of Warships and Machinery Under Construction in England. A review of ships under construction and their equipment. 2500 w. Engr, Lond—July 10, 1908. No. 93896 A.

Cruisers.

Description and Trials of U. S. S. Chester. A. F. H. Yates. Ills. 10000 w. Jour Am Soc of Nav Engrs—May, 1908. No. 94001 H.

The Trials of the Scout Cruiser "Salem." An illustrated account of the trials of a cruiser equipped with Curtis turbines. 2500 w. Sci Am—July 11, 1908. No. 93597.

The Indian Pilot Cruiser "Lady Fraser." Illustrated description by a twin-screw steamer designed to be a floating home for pilots. 1200 w. Engng—July 17, 1908. No. 93985 A.

Electric Power.

Electrical Equipment of Ships. W. D. Kirkpatrick. Read before the Liverpool Engng. Soc. Considers the applications made and the advantages secured by the use of electricity on shipboard. 2500 w. Mech Wld—June 26, 1908. Serial, 1st part. No. 93548 A.

We supply copies of these articles. See page 982.

Explosives.

Smokeless Powders. Editorial on the explosion on board the Jena, and the reports investigating the causes of the disaster. 2200 w. Engng—July 10, 1908. No. 93892 A.

Fire Boats.

Fire Fighting Equipment for Tugboats. R. H. Newbern. Read before the Nat. Fire Protection Assn. Describes the equipment of tug-boats with fire-fighting appliances. 1800 w. R R Age Gaz—July 24, 1908. No. 93940.

Lusitania.

Speed Trials and Service Performance of the Cunard Turbine Steamer Lusitania. Thomas Bell. Read before the Inst. of Nav. Archts. Describes the turbine machinery and its running, reporting the various trials made. Ills. 3000 w. Engr, Lond—July 10, 1908. No. 93898 A.

Mauretania.

The Recent Runs of the "Mauretania." Editorial discussion of recent trans-Atlantic records and the conditions under which the runs were made. 1200 w. Engng—June 19, 1908. No. 93429 A.

Oil Fuel.

Oil Fuel for Ships. Reviews the progress made in the application to the vessels in the merchant service, illustrating types of burners, and describing the Körting system. 2500 w. Engng—June 19, 1908. No. 93425 A.

Pinnaces.

Steam-Pinnaces for Naval Service. Illustrates and describes 12 steam-pinnaces built in England for the Argentine navy. 500 w. Engng—July 10, 1908. No. 93891 A.

Propellers.

A Comparison of Propeller Theories (Vergleichung von Propeller Theorien). Rudolf Mewes. A mathematical paper. Serial, 1st part. 2000 w. Die Turbine—June 20, 1908. No. 93672 D.

Resistance.

A Comparative Criticism of Formulæ for the Determination of Ship Resistance and Their Utility (Vergleichende Kritik der Formeln zur Bestimmung des Schiffswiederstandes und ihre Brauchbarkeit). Albert Achenbach. Mathematical and theoretical. Ills. 3500 w. Serial, 1st part. Die Turbine—June 5, 1908. No. 93667 D.

Shipbuilding.

Harland and Wolff's Works at Southampton. Illustrated detailed description of new shipbuilding works and their equipment. Plates. 3500 w. Engr, Lond—July 17, 1908. No. 93979 A.

Ship Design.

A New System of Ship Construction. J. W. Isherwood. Read before the Inst. of Nav. Archts. Illustrated detailed description of the arrangement of the framework, and information concerning stresses, erection, etc. 4500 w. Engng—June 19, 1908. No. 93433 A.

Framing of Vessels. E. Hall Craggs. A review of such structures and systems as have come within the writer's experience, and description of the longitudinal system with which Mr. Isherwood's name is associated. Discussion. 11 plates. 6000 w. Trans N-E Coast Inst of Engrs & Shipbldrs—June, 1908. No. 93452 N.

Steamboats.

New Southern Steamers. Illustrated description of the steamboat John W. Callahan, steamboat Lucille, and tug Cuba, with notes on other craft. 1500 w. Naut Gaz—July 23, 1908. No. 93906.

Steam Boilers.

Hints on the Construction of Water-Tube Boilers (Winke für die Konstruktion von Wasserrohrkesseln). Köhn v. Jaski. Discusses recent types for marine purposes. Ills. 3000 w. Schiffbau—June 10, 1908. No. 93660 D.

Steam Engines.

A Practical Comparison of the Advantages of Higher Cylinder Ratios. C. S. Root. Gives an account of two moderately long runs with the same vessel with different cylinder ratios. 1800 w. Jour Am Soc of Nav Engrs—May, 1908. No. 94002 H.

Steam Turbines.

The Weight of Marine Turbines. Discusses the tendency to increase in weight, the causes, and means whereby the weight can be safely reduced. 2200 w. Engr, Lond—June 19, 1908. No. 93434 A.

Steering Gear.

The Continuous Indication of the Work of Steering Engines During Operation (Die fortlaufende indikatorische Untersuchung von Rudermaschinen während der Rudermanöver). Herr Praetorius. Describes a method and illustrates results obtained. Serial, 1st part. 3000 w. Schiffbau—June 24, 1908. No. 93661 D.

Superheaters.

Recent Designs of Superheaters for Marine Boilers (Konstruktive Neuerungen an Ueberhitzern für Schiffskessel). Carl Züblin. Illustrates and describes a number of types. 2000 w. Serial, 1st part. Die Turbine—June 5, 1908. No. 93669 D.

The Design of Recent Superheaters for Marine Boilers (Berechnung neuerer auch für Schiffskessel verwendbarer Ueberhitzer). P. Brauser. The first part discusses mathematically the Jacobi superheater. Ills. Serial, 1st part. 1500 w. Die Turbine—June 5, 1908. No. 93671 D.

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MECHANICAL ENGINEERING

AUTOMOBILES.

Cabs.

Motor Cabs in Paris (Les Fiacres automobiles à Paris). L. Périssé. Discusses the Paris traffic problem, the economic importance of the motor-cab service, with notes on the technical details of their operation and maintenance. Ills. 12000 w. Mem Soc Ing Civ de France—March, 1908. No. 93606 G.

Commercial Vehicles.

Motor Turntable Fire Escape for Shanghai. Illustrated description of a petrol motor turntable fire escape. 700 w. Engr, Lond—July 3, 1908. No. 93735 A.

The Commercial Vehicle Exhibit (Concours de Véhicules industriels). E. Girardault. A general discussion of the models shown at a show held in Paris, May, 1908. Ills. 4000 w. Génie Civil—June 13, 1908. No. 93624 D.

Notes of an Electric Vehicle Expert on the Results of Herr Reichel's Tests in the Berlin Fire Department (Bemerkungen eines Elektromobil-Fachmannes zu den Ergebnissen der Berliner Versuche des Branddirektors Reichel). Carl Schirmbeck. Criticizes some of Herr Reichel's conclusions on electric vehicles. 3600 w. Zeitschr d Mit Motorwagen-Ver—June 30, 1908. No. 93674 D.

Construction.

See Foundries, Machine Tools, and Shops, under MACHINE WORKS AND FOUNDRIES.

Dentz.

The 40-60 Horse Power Deutz Car (Der 40-60 pferdige Motorwagen der Gasmotoren-Fabrik Deutz, Cöln-Deutz). A. Heller. Illustrated detailed description. 2400 w. Zeitschr d Ver Deutscher Ing—June 6, 1908. No. 93684 D.

Electric.

Power Calculations for Electric Vehicles. W. J. Aitken. Reports the results of over 150 tests under different conditions. 1200 w. Am Mach—July 16, 1908. No. 93786.

See Storage Batteries, under AUTOMOBILES.

E-M-F.

Details of the E-M-F "30" '09 Model A. Illustrated description of a new medium-priced car. 2000 w. Automobile—July 30, 1908. No. 94053.

Fuels.

Comparison Between Benzol and Gasoline for Automobiles (Comparaison entre le Benzol et l'Essence pour les Automobiles). A. Grebel. Gives particular attention to the properties of benzol. Ills. 4000 w. Génie Civil—June 13, 1908. No. 93625 D.

Garages.

The Marché Saint-Honoré Garage and Its Automobile Hoist (Garage avec Monte-automobile installé dans le Marché Saint-Honoré, à Paris). G. Leroux. Devoted principally to a description of the mechanism of the elevator. Ills. Plate. 2800 w. Génie Civil—June 20, 1908. No. 93626 D.

Ignition.

Recent Developments in Magneto Ignition. Otto Heins. Illustrates and describes devices and improvements of the Bosch Magneto Co. 2500 w. Automobile—July 2, 1908. No. 93492.

Motors.

Motor Engine Design. The discussion is confined to petrol engines applied to motor vehicles. 1800 w. Prac Engr—July 3, 1908. Serial, 1st part. No. 93719 A.

Napier.

The Napier Grand Prix Cars. Illustrations and brief description of one of the six-cylinder Napier cars built for this race. 1400 w. Autocar—July 18, 1908. No. 93965 A.

Peerless.

Peerless Models 19 and 25 for the Season of 1909. Illustrated detailed description of a 4-cylinder 30 horse power car and a 6-cylinder 50 horse power car. 2000 w. Automobile—July 16, 1908. No. 93818.

Racing Cars.

The British Racing Cars for the Grand Prix. Illustrates and describes the Austin cars, and the Weigel cars. The latter are of the live-axle type. 3000 w. Auto Jour—July 4, 1908. No. 93717 A.

Steam.

Steam from a Petrol Standpoint. A summary of knowledge gained by running a 30 h.p. White car. Ills. 3000 w. Auto Jour—July 18, 1908. Serial, 1st part. No. 93964 A.

Storage Batteries.

The Storage Battery in Automobile Work. Bruce Ford. Considers the Faure or Brush type of battery only, discussing the various uses in an automobile. 3500 w. Automobile—July 9, 1908. No. 93584.

Tires.

Points in the Tyre Problem. Goeffrey de Holden-Stone. Presents the advantages of the Victoria suspension system as a solution of the tyre problem. 2500 w. Autocar—July 4, 1908. No. 93716 A.

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The Making of G. & J. Tires. Illustrated description of stages in the process of manufacturing tire casing at an Indianapolis factory. 1500 w. Automobile —July 2, 1908. No. 93493.

COMBUSTION MOTORS.

Fuels.

Alcohol as a Fuel for Internal-Combustion Engines. Thomas L. White. Discusses the sources of a cheap and ample supply of fuel alcohol. 4000 w. Engineering Magazine—Aug., 1908. Serial, 1st part. No. 94016 B.

Gas Engine Ignition.

Induction Coils for Gas Engines. Eric J. Edwards. Deals only with the "make-and-break" or "touch-spark" method of ignition. 4000 w. Transit, Univ of Iowa —Vol. XIII, 1908. No. 93766 N.

Gas Engine Indicators.

Defects in an Indicator Reducing Motion. Walter H. Adams. Explanation of the defect and method of correcting it. 1200 w. Power—July 14, 1908. No. 93753.

Gas Engines.

800-B.-H.-P. Twin Cylinder Two-Cycle Gas-Engine with Electric Generator. Illustration, with description, of an engine at the Franco-British Exhibition. 1700 w. Engng—June 19, 1908. No. 93432 A.

No Load Gas-Engine Tests (Leergangversuche an Gasmaschinen). R. Schöttler. Gives the results of tests on four four-cycle engines. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—June 20, 1908. No. 93686 D.

Gasoline Engines.

Adams-Farwell Aeronautic Gasoline Motor. Illustrated description. 1600 w. Mach, N Y—July, 1908. No. 93458 C.

New 5-Cylinder Aeronautical Motor. Illustrated description of the Adams-Farwell motor, which is of exceedingly light weight per h. p. 2000 w. Am Mach —Vol. 31, No. 27. No. 93475.

See also Motors, under AUTOMOBILES.

Gas Power Plants.

An Interurban Railway Gas Power Station. Cecil P. Poole. Illustrated description of the Western New York & Penn. Traction Co.'s power plant and its performance. 2000 w. Power—July 14, 1908. No. 93748.

Gas Producers.

Why Gas Producers Are Not More Successful. T. F. Christopher. Describes the three types in general use, discussing the difficulties common to each. 3000 w. Power—June 30, 1908. No. 93438.

The Carbon-Monoxide Gas Producer. W. Y. Lewis. Illustrated description of the plant installed in the works of the John Thomson Press Co., in Long Island City, stating the advantages of this process. 4000 w. Cassier's Mag—July, 1908. No. 93444 B.

HEATING AND COOLING.

Cooling Sprays.

Cooling Condensing Water by Means of Spray Nozzles. Illustrated description of this system. 1500 w. Power—July 14, 1908. No. 93754.

Electric Heating.

Heating and Ventilating by Electricity (Le Chauffage et la Ventilation par l'Electricité). R. Périssé. A review of methods and appliances. Ills. 2800 w. Bul Soc d'Encour—May, 1908. No. 93615 G.

Hot-Air Heating.

Cast-Iron Heaters for Hot-Blast Work. Theodore Weinshank. Read before the Am. Soc. of Heat. & Vent. Engrs. Reports problems that developed in the course of tests made of a heater for the hot-blast system. Ills. 2500 w. Heat & Vent Mag—July, 1908. No. 93992.

Refrigeration.

The Absorption System Made Simple. Lewis C. Reynolds. An explanation of the heat-unit theory and its application. 1200 w. Power—June 30, 1908. No. 93437.

Management of an Absorption Plant. W. S. Luckenbach. Discusses some of the causes of breakdowns, their prevention and repair. 2500 w. Cold Storage & Ice—July, 1908. Serial, 1st part. No. 93794 C.

Compression vs. Absorption Plants. Thomas Shipley. Discusses recent claims made as to the remarkable performances of absorption, or of combined plants. 4500 w. Ice & Refrig—July, 1908. No. 93574 C.

A Novel Cooling Installation. Dr. A Gradenwitz. Illustrates and describes a plant designed by Prof. Linde, of Munich, for the hospital at Togo, in German West Africa. 900 w. Sci Am Sup—July 11, 1908. No. 93700.

See also same title, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

School Buildings.

Simplifying the Installation and Operation of School Heating and Ventilating Apparatus. S. R. Lewis. Read before the Am. Soc. of Heat. & Vent. Engrs. Gives a description of a typical plan of heating and ventilating apparatus of the simplest steam plant; also furnaces with fans. 1400 w. Heat & Vent Mag—July, 1908. No. 93993.

Steam Heating.

The Movement of Damp Steam in Long Pipe Lines (Ueber die strömende Bewegung nasser Dämpfe in langen Leitungen). R. Trautmann. A mathematical

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discussion of some steam-heating problems. Ills. 5000 w. Gesundheits-Ing—June 20, 1908. No. 93663 D.

Theatres.

Heating and Ventilating of the Brooklyn Academy of Music. A monumental structure of composite design, most completely equipped for ample ventilation and heating, and the apparatus installed is described. Ills. 4500 w. Eng Rec—July 25, 1908. Serial, 1st part. No. 93924.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

Centrifugal Pumps. Ezra E. Clark. Describes their operation in the field of fire pumps. Ills. 4500 w. Ins Engng—July, 1908. No. 94007 C.

Electric Pumping.

See Pumping, under MINING AND METALLURGY, PUMPING.

Hydraulic Plants.

A Large Hydraulic Development and Wood Pulp Mill in Canada. Illustrated detailed description of the engineering and hydraulic development of the pulp mill at Espanola, Ontario. 5500 w. Eng Rec—July 11, 1908. No. 93702.

Pumping Engines.

Tests of Pumping-Engines of the Rand Water Board, Zwaart-Kopjes Station. Describes the engines and gives results of tests. 700 w. Engng—July 10, 1908. No. 93889 A.

Pumps.

Locating Defects in Steam Pumps. W. H. Wakeman. An account of troubles and their cause. Ills. 900 w. Power—July 14, 1908. No. 93752.

Proper Thickness of a Valve Deck in a Pump. William F. Fisher. Methods of calculating are given. 700 w. Power—July 7, 1908. No. 93532.

Turbine Plants.

Large Modern Turbine Plants (Grosse moderne Turbinenanlagen). L. Zodel. The first part is a general introduction to a series of descriptions of large water-power plants in Europe. Ills. Serial. 1st part. 1500 w. Schweiz Bau—June 13, 1908. No. 93649 I.

The "La Dernier" Hydraulic Power Plant on the Orbe (Wasserkraftanlagen "La Dernier" am Orbe). A. Stoll. An illustrated detailed description of this Swiss plant. Serial. 1st part. 1500 w. Zeitschr f d Gesamte Turbinenwesen—June 10, 1908. No. 93664 D.

Turbines.

Turbine Blades (Die Schaufelenden der Kreiselräder). Dr. H. Lorenz. A mathematical discussion of their design. Ills. 3500 w. Zeitschr f d Gesamte Turbinenwesen—June 30, 1908. No. 93666 D.

Series Construction of High-Speed Compound Turbines (Construction en Série des Turbines mixtes à grande Vitesse). J. Lafitte. A discussion of the type with notes on the design. Ills. 2200 w. Génie Civil—June 6, 1908. No. 93623 D.

Notes on the Design and Construction of Turbine Machinery (Beiträge zur Berechnung und konstruktion der Turbomaschinen). W. Wagenbach. Discusses principally the design of the rotor of hydraulic turbines. Ills. Serial. 1st part. 1100 w. Zeitschr f d Gesamte Turbinenwesen—June 20, 1908. No. 93665 D.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

See same title, under MACHINE WORKS AND FOUNDRIES.

Cams.

Cam Applications. George W. Armstrong. Illustrates and describes various mechanisms employed in connection with cams. 2500 w. Mach, N Y—July, 1908. No. 93457 C.

Couplings.

The New Coupling of the Berlin-Anhaltischen Maschinenbau-A.-G. (Die neue Kraftmaschinenkupplung der Berlin-Anhaltischen Maschinenbau-A.-G.) O. Ohnesorge. Illustrated detailed description. 4500 w. Zeitschr d Ver Deutscher Ing—June 27, 1908. No. 93687 D.

Crossheads.

See Engine Design, under STEAM ENGINEERING.

Gears.

Direction of Rotation of Epicyclic Gears. Reprint of an article by A. T. Woods, which appeared in 1889, with remarks on its value, by Oscar J. Beale. 2200 w. Am Mach—Vol. 31. No. 28. No. 93586.

The Safe Working Loads for Gear Teeth. Charles H. Logue. Gives charts for designing teeth for wear, and taking into consideration hardness, and elastic limit of material, etc. 1000 w. Am Mach—Vol. 31. No. 30. No. 93916.

Graphics.

A New Development in Cross-Section Paper. Henry Hess. Presents an improvement in cross-section paper, explaining its advantages and use in the graphic derivation of an expression, law or formula defining the quantitative relationship of plotted observations. 6800 w. Pro Engrs' Club of Phila—April, 1908. No. 94005 D.

Mechanics.

A Revision of the Fundamental Laws of Matter and Energy. Gilbert N. Lewis. Aims to show that a simple system of mechanics may be constructed, which is consistent with all known experimental

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facts. 3500 w. Tech Qr—June, 1908. No. 93772 E.

Mensuration.

The Guldin Theorems (Les Théorèmes de Guldin). M. Nachtergal. Shows the derivation of various formulae in mensuration and the application of the method to finding the volume of machine parts. Ills. 3000 w. All Indus—June, 1908. No. 93620 D.

Riveted Joints.

Calculating the Strength of Riveted Joints. S. F. Jetter. Showing how such calculations can be made by simple arithmetic. 4500 w. Power—July 7, 1908. No. 93536.

Speed Changing.

A Speed-Changing Mechanism Without Gears. H. M. Russell, Jr. Brief description of a novel differential movement. Ills. 800 w. Am Mach—Vol. 31. No. 29. No. 93787.

Stresses.

Guest's Law on Combined Stresses. C. A. Smith. Discusses instances illustrating combined stresses, giving results of calculations and describing difficult experiments which have led to the acceptance of Guest's law. Ills. 3500 w. Engng—July 10, 1908. No. 93887 A.

Wheels.

Designing Wheels for Corliss Engines. L. L. Willard. Gives directions for determining the required diameter and face, and for finding the proper weight of wheels for various cases. 2000 w. Power—July 21, 1908. No. 93844.

MACHINE WORKS AND FOUNDRIES.

Aluminium Founding.

Method of Making Aluminum Castings in a Connecticut Foundry. Illustrates and describes methods used at Fairfield, Conn. 2400 w. Brass Wld—July, 1908. No. 93846.

Annealing.

See Furnaces, under MACHINE WORKS AND FOUNDRIES.

Ball Bearings.

The Production of Ball Bearings (Die Herstellung der Kugellager). Fritz Huth. Describes the machines used. Ills. 1500 w. Serial. 1st part. Zeitschr f Werkzeng—June 15, 1908. No. 93653 D.

Boiler Making.

Building the Modern High Power Boiler. Discusses rivet and plate heating practice and effect of high altitudes on stack draft. 2500 w. Ir Trd Rev—July 30, 1908. No. 94052.

Design and Construction of a Marine Boiler. Describes some of the difficulties met in the shop in building a boiler of the water-back marine type. 3300 w. Boiler Maker—July, 1908. No. 93468.

Flanging Boiler Plates. Frank B. Kleinhans. The present number illustrates and describes early methods of flanging. 1200 w. Boiler Maker—July, 1908. Serial. 1st part. No. 93469.

Boring Mills.

Vertical Turning and Boring Mill at the Franco-British Exhibition. Joseph Horner. Illustrates and describes a 4 ft. mill having novel features; notably a chain-drive to a worm which turns the table. 1500 w. Engng—July 17, 1908. No. 93983 A.

Brass Founding.

The Leakage of Castings Under Pressure. Considers some of the causes of leakage and the best methods of remedying the trouble. Ills. 1400 w. Brass Wld—July, 1908. No. 93849.

Improving the Appearance of Cheap Brass. Walter J. May. Helpful suggestions for the treatment of castings. 900 w. Prac Engr—July 17, 1908. No. 93971 A.

Prolonging the Life of Crucibles. Dudley A. Johnson. Read before the Am. Brass Found. Assn. Suggestions for improvement in crucible manufacture and use. 2000 w. Foundry—July, 1908. No. 93575.

See also Electro-Plating, under ELECTRICAL ENGINEERING, ELECTRO-CHEMISTRY.

Brazing.

Brazing (Das Hartlöten). August Bauschlicher. Discusses applications, methods and appliances. Ills. 3500 w. Zeitschr f Werkzeng—June 15, 1908. No. 93654 D.

Castings.

Large Castings (Grosse Guszstücke). C. Irresberger. A discussion of difficulties in their production and means of overcoming them. Ills. Serial. 1st part. 1800 w. Stahl u Eisen—June 3, 1908. No. 93634 D.

Hard Spots in Steel Castings, with an Account of Certain Diffusion Phenomena. Arthur P. Scott. Detailed account of an investigation made of a hard spot encountered in a steel roll. Ills. 5000 w. Elec-Chem & Met Ind—July, 1908. Serial. 1st part. No. 93456 C.

Chain Making.

Making Weldless Chains by the Annular Rolling Method (La Fabrication des Chaines sans Soudure par le Procédé du Laminage annulaire). Eng. François. Discusses the process and the product. Ills. Serial. 1st part. 5500 w. All Indus—June, 1908. No. 93619 D.

Core Boxes.

See Molding, under MACHINE WORKS AND FOUNDRIES.

Drawing Presses.

See Sheet-Metal Working, under MACHINE WORKS AND FOUNDRIES.

Straight Floor Car Wheel Foundry. Illustrated description of the operating methods of the Dickson Car Wheel Co., Houston, Texas. 1200 w. Foundry—July, 1908. No. 93570.

Foundries.

Foundry Plants and Machines for Automobile Construction (Giesserei-Anlagen und Maschinen für den Automobilbau). Illustrates and describes many types of molding machines and the arrangement of a typical foundry for the production of automobile castings. 4000 w. Zeitschr f Werkzeug—June 25, 1908. No. 93655 D.

Foundry Materials.

Ferro-Alloys in the Foundry. W. M. Saunders. Read before the Am. Found. Assn. Discusses the use of various alloys and the properties they impart to cast iron. 2000 w. Foundry—July, 1908. No. 93576.

Furnaces.

Small Annealing Furnaces and Muffles. Walter J. May. Suggestions for their construction and use. Ills. 700 w. Prac Engr—July 3, 1908. No. 93721 A.

A Twin Chambered High-Speed Furnace. S. N. Brayshaw. A new patented furnace for hardening high-speed steel, using either gas or oil for fuel, is illustrated and described. 2500 w. Am Mach—Vol. 31, No. 31. No. 94039.

Grinding.

Emery Wheels and Their Uses. Hints on the situation, use, and application of emery wheels. Ills. 2500 w. Mech Engr—July 10, 1908. Serial. 1st part. No. 93863 A.

Grinding Disk Tests. Illustrated account of tests made by the Gardner Machine Co., Beloit, Wis., to determine the comparative efficiency of different kinds of abrasive disks. 1500 w. Ir Age—July 30, 1908. No. 94037.

Grinding Machines.

See Shop Appliances, under MACHINE WORKS AND FOUNDRIES.

Guns.

Vickers Ordnance at the Franco-British Exhibition. Illustrates and describes improvements represented by these exhibits. Plate. 3500 w. Engng—June 26, 1908. No. 93560 A.

Lathes.

9¼-In. High-Speed All-Geared Lathe. Illustrated description of a lathe shown by the Colchester Lathe Co., at the Franco-British exhibition. 1500 w. Engng—June 19, 1908. No. 93427 A.

Sliding, Surfacing, and Screw-Cutting Lathe; Franco-British Exhibition. Illustrated description of a lathe of this type exhibited by M. Emile Chonânard. 500 w. Engng—June 19, 1908. No. 93426 A.

Machine Tools.

The Franco-British Exhibition. Calls attention to some interesting exhibits in the British machinery section. 3300 w. Engng—July 17, 1908. No. 93980 A.

Some Interesting German Machine Tools. J. W. Carrel. Illustrates and describes tools showing originality of design. 2000 w. Am Mach—Vol. 31. No. 31. No. 94041.

A Noteworthy Combination Machine Tool. Illustrates and describes a machine capable of a great variety of work on heavy castings. 1200 w. Am Mach—Vol. 31. No. 28. No. 93585.

All-Gear Drives for Machine Tools. Thomas R. Shaw. Illustrates and describes some of the most recent examples of this style of drive. 1500 w. Mech Engr—July 10, 1908. Serial. 1st part. No. 93861 A.

Special Machines and Tools Used in Upright Drill Manufacture. Illustrates and describes interesting special tools used in a shop at Rockford. Ill. 3500 w. Mach, N Y—July, 1908. No. 93460 C.

Special Tools and Appliances for the Manufacture of Automobile Parts (Spezial Maschinen und Vorrichtungen für die Herstellung von Automobilteilen). Ernst Valentin. A profusely illustrated article describing European machines and methods. Serial. 1st part. 4000 w. Zeitschr f Werkzeng—June 15, 1908. No. 93652 D.

Milling Machines.

The Milwaukee High Power Miller. Illustrated description of the Milwaukee No. 3-B universal milling machine. 3500 w. Ir Age—July 30, 1908. No. 94035.

An English Milling Machine with Independent Belt Feed. I. W. Chubb. Illustrated description. 700 w. Am Mach—Vol. 31. No. 29. No. 93785.

A design for a Plain Milling Machine. H. F. Noyes. Illustrates a machine with a constant belt speed with sixteen changes and all gears in oil. 1200 w. Am Mach—Vol. 31. No. 29. No. 93784.

A Double-Spindle Spline Milling Machine. Illustrated description of a novel machine with two cam-controlled spindles and reciprocating table for feeding the work between the cutters. 2000 w. Am Mach—Vol. 31. No. 27. No. 93473.

Molding.

All-Core Molding of Turbine Rings. Joseph Horner. Illustrated description of the design and construction of core boxes and methods of molding. 1200 w. Am Mach—Vol. 31. No. 28. No. 93588.

Molding Machines.

A Multiple Molding Machine. James Cooke Mills. Illustrates and describes the invention of John A. Rathbone. 700 w. Sci Am—July 18, 1908. No. 93798.

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Bonvillian & Ronceray Molding Machines (Ein neues Formverfahren und seine Maschinen Patent Bonvillian & Ronceray). A. F. Hager. Illustrated description of various machines. 3000 w. Zeitschr d Oest Ing u Arch Ver—June 26, 1908. No. 93658 D.

See also Foundries, under MACHINE WORKS AND FOUNDRIES.

Molding Sands.

Relative Values of the Physical and Chemical Examinations of Molding Sands. Heinrich Ries. Read before the Am. Brass Found. Assn. Gives evidence leading to the conclusion that the physical tests are far more important. 2500 w. Foundry—July, 1908. No. 93573.

Pattern Making.

Patterns for Twin Locomotive Cylinders. C. Patton. Illustrates and describes methods used. 1000 w. Am Mach--Vol 31. No. 31. No. 94040.

Pipe Founding.

Progress in Pipe Founding (Neuerungen in Röhrengiessereien). Oskar Simmersbach. A review of recently introduced processes and appliances. Ills. 3500 w. Stahl u Eisen—June 17, 1908. No. 93636 D.

Saws.

The Teeth of Circular Saws (Ueber die Zahnung von Kreissägen). D. Dominicus. Illustrates many tooth forms and discusses their efficiency and application to various classes of work. 2000 w. Zeitschr f Werkzeng—June 5, 1908. No. 93650 D.

Sheet-Metal Working.

Sheet-Metal-Working Tools at the Franco-British Exhibition. Joseph Horner. Illustrated description of interesting exhibits. 3000 w. Engng—July 10, 1908. No. 93888 A.

Shop Appliances.

Some Special Tools Used in Italian Shops. E. Domon. Illustrates and describes ingenious fixtures used in machining carburetters, etc. 1400 w. Am Mach —Vol. 31. No. 28. No. 93587.

Tools and Equipment in Structural Shops. George P. Thomas. Suggestions of value. Also general discussion. 6500 w. Pro Engrs' Soc of W Penn—July, 1908. No. 94023 D.

The Aerochuck and a Few of Its Many Uses. E. F. Lake. Illustrated descriptions of chucks and clamps which are opened and closed by compressed air, explaining their usefulness. 2000 w. Am Mach—Vol. 31. No. 30. No. 93915.

Tools and Methods of the E. Howard Watch Co. F. A. Stanley. Illustrates and describes grinding machine and miller attachments and some bench lathe and other appliances used in connection with accurate watch work. 3000 w. Am Mach—Vol. 31. No. 29. Serial. 1st part. No. 93783.

See also Machine Tools, under MACHINE WORKS AND FOUNDRIES.

Shop Hygiene.

The Idea of Personal Hygiene in Industry (La Notion de l'Hygiène individuelle dans l'Industrie). A. Beauquis. Discusses the moral obligation on employers to secure sanitary surroundings for workmen and the economic effects of industrial betterment. 4500 w. Rev d'Econ Indus—June, 1908. No. 93602 D.

Shop Practice.

Machining a Crankshaft for a Three-Throw Pump. S. Laurence. Prize paper. Illustrated detailed description of the work. 1200 w. Mech Wld—July 10, 1908. No. 93860 A.

The Development of Mechanical Movements. J. G. Vincent. Describes the laying out of metal parts accurately by means of master plates bored to centers corresponding to those found in the machine frames. 2000 w. Am Mach—Vol. 31. No. 27. No. 93476.

The Product and Methods of European Locomotive Works. Charles R. King. This third and concluding article of a series considers principally the machine tools and shop methods in practice in Italy and on the Continent. Ills. 3500 w. Engineering Magazine—Aug., 1908. No. 94014 B.

Shops.

The New Works of Messrs. Peter Brotherhood, Ltd. Illustrated description of the new works at Peterborough, for the manufacture of engines, air compressors, etc. Plate. 3000 w. Engng—July 17, 1908. No. 93981 A.

Automobile Shops (Automobil-Fabrikanlagen). Ernst Valentin. Enumerates and discusses the various departments of an automobile works and comments on the organization necessary. Ills. 2500 w. Zeitschr f Werkzeng—June 15, 1908. No. 93651 D.

Shop Ventilation.

Purity of Air in Factories (La bonne Aération des Ateliers). M. Perbost. A discussion of ventilation problems in relation to the effect of impure air on workmen. 3500 w. Serial. 1st part. Rev d'Econ Indus—June, 1908. No. 93603 D.

Taps.

Special and Adjustable Taps. Erik Oberg. Illustrates and describes a number of forms. 2500 w. Mach, N Y—July, 1908. No. 93461 C.

Tempering.

Hardening High-Speed Steel Tools by the Barium-Chloride Process. O. M. Becker. A working description of the operations and appliances needed. Ills.

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3000 w. Engineering Magazine—Aug., 1908. No. 94015 B.

Tools.

Making and Using of High-Speed Steel Tools. A. L. Valentine. Discusses the composition of the metal, results of practical work, and other matters relating to this material. 4000 w. Am Mach—Vol. 31. No. 93474.

Wire Drawing.

A New Friction Block for Wire Drawing Frames. Illustrated description of the Carroll friction block which has a friction clutch of the coil type designed to meet the requirements of wire-drawing. 2500 w. Ir Age—July 30, 1908. No. 94036.

Woodworking Machines.

Machines for Making Slack-Barrels. Illustrated description of special machinery for making barrels for Portland cement. 1500 w. Engng—June 26, 1908. No. 93562 A.

MATERIALS OF CONSTRUCTION.

Alloys.

Magnalium. Notes on the valuable characteristics of this aluminum alloy. 1300 w. Mach, N Y—July, 1908. No. 93459 C.

New Applications of Electro-Metallurgical Alloys. Ad. Jouve. Abstract of a paper read before the Faraday Soc. Concerning the production of material capable of resisting acids. 700 w. Ir & Coal Trds Rev—June 26, 1908. No. 93568 A.

Alloy Steels.

The Static and Dynamic Properties of Steels. W. L. Turner. On the need of thorough investigation of different alloy steels, reporting test results obtained by the writer. 4000 w. Ir Age—July 2, 1908. No. 93465.

Aluminium.

See Aluminium Founding, under MACHINE WORK AND FOUNDRIES.

Bronze.

The Metallurgy of the Bronze Age. W. M. Corse. Read before the Am. Brass Found. Assn. A discussion of the bronze age in Europe, including a reference to early practice and mixtures. 3000 w. Foundry—July, 1908. No. 93571.

Heat Insulation.

The Conductivity of Heat Insulating Materials (Die Wärmeleitfähigkeit von Wärmeisolierstoffen). Wilhelm Nusselt. Gives the results of tests on a number of materials. Ills. Serial. 1st part. 5500 w. Zeitschr d Ver Deutscher Ing—June 6, 1908. No. 93682 D.

Manganese Bronze.

Manganese Bronze. C. R. Spare. From a paper read before the Am. Soc. for Test Materials. Concerning the value of this metal, the testing methods, use and demands. 1200 w. Ir Age—July 30, 1908. No. 94038.

Metallography.

Note on the Structure of a Brittle Sheet of Very Low Carbon Steel. Albert Sauveur. Illustrated description of a peculiar structure. 400 w. Elec-Chem & Met Ind—July, 1908. No. 93453 C.

A Laboratory Experiment to Illustrate the Changes in Magnetic Properties Occurring at the Thermal Critical Points in Steel. H. M. Boylston. Describes the method and apparatus used, giving suggestions for the practical application of the principle involved. 1300 w. Elec-Chem & Met Ind—July, 1908. No. 93454 C.

The Carbon-Iron Diagram. Henry M. Howe. Gives the reasons which led to Roozeboom's form of the diagram, and those that led to the replacing it with the double diagram. Also considers the graphite-iron diagram and related matters. 21000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94026 E.

A Contribution to the Study of Steels Containing Phosphorus (Contribution à l'Etude des Aciers Phosphoreux). M. J. de Kryloff. A metallographic study of the effects of various amounts of phosphorus on the properties of steel. Ills. 1300 w. Rev de Métal—June, 1908. No. 93697 E + F.

Steel.

Loop Eyes and Upset Ends on Steel Rods. Malverd A. Howe. A report of tests made to get information as to causes of failure. 800 w. R R Age Gaz—July 31, 1908. No. 94054.

Wood.

Tests of Vehicle and Implement Woods. H. B. Holroyd and H. S. Betts. Gives results of tests made to obtain a better knowledge of their mechanical properties. Ills. 5600 w. U S Dept of Agri—Circ 142—No. 93758 N.

MEASUREMENT.

Dynamometers.

The Rotation Dynamometer (Dinanmómetre de Rotacion sistema M. Donat Banki). César Serano. Illustrates and gives a mathematical analysis of the design. 3000 w. Energia Elec—June 25, 1908. No. 93632 D.

Hardness.

Notes on the Rebounds of a Ball and the Information They May Give as to the Hardness and Elasticity of Bodies (Remarques sur les Rebondissements d'une Bille et les Renseignements qu'ils peuvent donner sur la Dureté et l'Elasticité des Corps). M. de Fréminville. Refers to the Shore sclerometer. Also discussion by M. M. Breuil, Mauer, and Mesnager. 9000 w. Rev de Métal—June, 1908. No. 93699 E + F.

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Testing Materials.

The Testing of Alloys. W. B. Parker. Read before the British Found. Assn. A general survey of the subject with illustrations from the writer's experience. Ills. 6000 w. Engng—July 10, 1908. No. 93894 A.

Notched-Bar Impact Tests. Deals with a report presented by Dr. Ing. Ehrensberger, of Essen, to the Deutsche Verband für Material-prüfungen. Ills. 2000 w. Engng—June 19, 1908. No. 93424 A.

Board of Trade Rules for Boiler Materials. A copy of circular, No. 1443, dealing with the manufacture and testing of steel material intended for boiler and machinery under Board of Trade Survey. 3000 w. Mech Engr—July 10, 1908. No. 93862 A.

Instructions to Surveyors. Circular, No. 1443, issued by the Marine Department of the Board of Trade, dealing with the manufacturing and testing of steel material intended for boilers and machinery. 2200 w. Engr, Lond—July 3, 1908. No. 93734 A.

POWER AND TRANSMISSION.

Air Compressors.

Compressing Air by an Improved Method. Jos. H. Hart. Information concerning the bucket pumps system of compressing air for mining work. 2200 w. Min Wld—July 25, 1908. No. 93957.

Compressed Air.

See Pipe Flow, under CIVIL ENGINEERING, WATER SUPPLY.

Costs.

The Cost of Power. W. N. Polakow. Discusses the correct method of determination and what it must show. 1500 w. Power—July 14, 1908. No. 93749.

Electricity in a Belgian Steel Works. Illustrated description of the equipment of extensive steel works of Tilleur, Belgium. 2500 w. Elec Wld—July 25, 1908. No. 93912.

Electric Driving.

Converting Hand-Blown Organs. J. W. Warr. Sketches and description of methods used in adapting hand-worked organs to use electric motors. 1500 w. Elec Rev, Lond—June 26, 1908. No. 93555 A.

Flywheels *versus* Storage Batteries for Equalizing Fluctuating Loads. G. C. Allingham. Shows the limitations of flywheel storage, and the advantage of employing storage batteries. 1300 w. Elect'n, Lond—July 10, 1908. No. 93873 A.

Gas Power.

Power Transmission. Prof. C. A. Smith. A comparative study of the merits of gas and electricity as applied to modern problems. 3000 w. Cassier's Mag—July, 1908. No. 93448 B.

Gearing.

See Machine Tools, under MACHINE WORKS AND FOUNDRIES.

Power Plants.

Works Engine Houses. Arthur Titley. An illustrated discussion of power-plant design for manufacturing and engineering plants. 2000 w. Cassier's Mag—July, 1908. No. 93441 B.

Building a Power Plant. John H. Ryan. Describes a concrete example; the building and equipment. Ills. 4500 w. Power—July, 1908. Serial. 1st part. No. 93851.

Power Plant of the Bryant Paper Company. George H. Chandler. Outline description of the steam plant of a large mill in Michigan. Ills. 1000 w. Power—July 21, 1908. No. 93842.

See also Coal Handling, under POWER AND TRANSMISSION.

Shafting.

Sizes of Shafts Without Mathematics. John H. Barr. Gives a chart for rapidly solving problems involved in designing or checking shafts, explaining its use. 3000 w. Power—June 30, 1908. No. 93439.

STEAM ENGINEERING.

Boiler Cleaning.

Cleaning Water-tube Boilers. Maurice W. Campbell. Directions for cleaning. 1200 w. Power—July 21, 1908. No. 93843.

Boiler Efficiency.

Boiler Efficiency. Walter Jones. From a paper before the (British) Inst. of Heat. & Vent. Engrs. An analysis of the ratings of house-heating boilers. 2500 w. Heat & Vent Mag—July, 1908. No. 93994.

See also Smoke Prevention, under STEAM ENGINEERING.

Boiler Feeding.

Automatic Boiler-Feed Controlling Apparatus. Illustrated description of an appliance recently shown at Olympia. 1000 w. Engng—July 10, 1908. No. 93893 A.

Boiler Furnaces.

See Fuels, under STEAM ENGINEERING.

Boiler Management.

See Fuels, under STEAM ENGINEERING.

Boiler Repairs.

Some Boiler Troubles and Their Remedies. Frank Collins. Discusses various troubles, suggesting remedies. 2500 w. Boiler Maker—July, 1908. No. 93467.

Boiler Settings.

Cement and Concrete for Boiler Setting. R. I. Blakney. Directions for the work with suggestions. Ills. 800 w. Power—July, 1908. No. 93850.

Boiler Tubes.

Bursting and Collapsing Pressures of Boiler Tubes. Ulrich Peters. Gives formulæ, illustrating their use by examples. 500 w. Power—June 30, 1908. No. 93440.

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Condenser Water.

See Cooling Sprays, and Cooling Towers, under HEATING AND COOLING.

Engine Design.

Design of Corliss Engine Crossheads. L. L. Willard. Illustrates and describes different types, commenting on the merits of each. 1000 w. Power—July 7, 1908. No. 93533.

See also Wheels, under MACHINE ELEMENTS AND DESIGN.

Engine Erection.

Lining-up a Horizontal Engine. C. R. Strother. Explains methods. Ills. 1500 w. Power—July 7, 1908. No. 93535.

Engines.

The Lentz Compound Engine. Illustrated detailed description of a compound drop valve steam engine. 1000 w. Engr, Lond—July 10, 1908. No. 93897 A.

Fuels.

Chemistry of Combustion. Charles F. Mabery. Read before the Int. Assn. for the Prevention of Smoke. Discusses the transformation of energy, as related to combustion. 4000 w. Ind Wld—July 13, 1908. No. 93737.

Fuel and Boiler Room Economics. C. H. Benjamin. Abstract of a paper before the Int. Assn. for the Prevention of Smoke. Suggestions on the installation of the plant, purchase and burning of fuel, etc. 2000 w. Power—July 28, 1908. No. 93990.

The Heat of Fuels and Furnace Efficiency. William D. Ennis. Defines heat, explaining how chemical composition determines heating value, and discusses other factors of combustion. 5000 w. Power—July 14, 1908. No. 93750.

Specifications for Steam Coal. A. C. Cunningham. Gives a specification believed to be reasonable and just, with explanation of the requirements, and the writer's experience. 3000 w. Jour Am Soc of Nav Engrs—May, 1908. No. 94000 H.

Use of Wood as Fuel for Steam Boilers. J. A. Johnston. Discusses the calorific value of various woods, the kind of furnace required, the size of chimney, and other conditions forming good practice. 2500 w. Power—June 30, 1908. No. 93436.

Fuel and Its Future. Vivian B. Lewis. This first lecture gives an outline of the fuels used and their development, and information relating to them. 4400 w. Jour Soc of Arts. July 17, 1908. Serial. 1st part. No. 93963 A.

Fuel Testing.

The Investigations of Fuels and Structural Materials by the Technologic Branch of the United States Geological Survey. Joseph A. Holmes. A report and historical sketch. 8000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94027 D.

Smoke Prevention.

City Supervision of New Boiler Plants. A discussion of Robert H. Kuss at the convention of the Int. Assn. for the Prevention of Smoke. 4000 w. Eng Rec—July 11, 1908. No. 93703.

Steam Jets and Their Uses. A. W Puddington. Read before the Int. Assn. for the Prevention of Smoke. Considers the use of the steam jet blast to secure perfect combination and prevent smoke. 3500 w. Ind Wld—July 13, 1908. No. 93738.

Steam Generation.

Modern Steam: Its Generation and Uses. Robert Bailie. Presents facts and suggestions from recent experience. Ills. 3000 w. Jour W of Scotland Ir & St Inst—March, 1908. No. 94008 N.

Steam Pipes.

Emergency Repairs to Steam Pipes. William Kavanagh. Devices for stopping leaks in pipes are illustrated and described. 1000 w. Elec Wld—July 4, 1908. No. 93480.

Superheating.

Effects on Superheating Moist Steam. J. C. William Greth. Gives reasons why boilers must deliver dry steam to obtain the best results from superheating. 4500 w. Power—July 7, 1908. No. 93534.

See also Superheaters, under MARINE AND NAVAL ENGINEERING; and Superheating, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Thermic Accumulators.

The Halpin Thermic Accumulator and Its Applications (L'Accumulateur Thermique Halpin et ses Applications). M. Izart. A discussion of the practical results obtained by its use. Ills. 2500 w. Rev de Mécan—June, 1908. No. 93613 E + F.

Turbine Auxiliaries.

Troubles with Steam Turbine Auxiliaries. Walter B. Gump. Describes a case where the circulating pump failed to meet the guarantee, the investigation and changes. 2000 w. Power—July 14, 1908. No. 93751.

Turbines.

Some Points to Be Considered in the Purchase of Steam Turbines. John Hays Smith. Brief consideration of features that assist in selection. 1600 w. Elec Age—July, 1908. No. 93470.

Centrifugal Force on Steam in Turbine Blading. Frank Foster. Investigates the nature of these centrifugal forces, considering their probable effects on the flow of steam through the blading. 800 w. Engr, Lond—July 17, 1908. No. 93078 A.

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The Zoelly Steam-Turbine. Illustrated detailed description of this turbine and information relating to it. Plates. 6000 w. Engng—July 3, 1908. No. 93731 A.

The Development of the Zoelly Turbine (Die Entwicklung des "Zoelly"-Dampfturbinenbaues). Illustrates and describes a number of installations. 2500 w. Die Turbine—June 5, 1908. No. 93668 D.

Steam Turbines (Dampfturbinen). Wilhelm H. Eyermann. The first part gives a general discussion of the various types. Ills. Serial. 1st part. 3000 w. Elektrotech Zeitschr—June 11, 1908. No. 93692 D.

Valve Setting.

Setting the Valves of the Wright Steam Engine. Hubert E. Collins. Directions for setting the gridiron valves. Ills. 3000 w. Power—July 7, 1908. No. 93531.

TRANSPORTING AND CONVEYING.

Ash Handling.

See Coal Handling, under POWER AND TRANSMISSION.

Coal Handling.

The Storage and Handling of Coal and Ashes in Power Plants. Werner Boecklin. Illustrates and describes mechanical appliances substituted for manual labor, and discusses requirements of storage. 2500 w. Cassier's Mag—July, 1908. No. 93445 B.

Cranes.

The Design of a Foundry Crane (Berechnung eines Giessereikranes). Adolf Knelles. Gives a complete mathematical demonstration of the method of designing a jib crane for heavy service. Ills. Serial. 1st part. 1200 w. Elektrotech. Rundschau—June 4, 1908. No. 93675 D.

Flange Friction in Hoisting Machinery (Die Spurkranzreibung bei Hebezeugen). E. Hillbrand. Discusses mathematically the friction due to the flanges of the wheels on which revolving and traveling cranes run. Ills. 2000 w. Elektrotech u Maschinenbau — June 21, 1908. No 93679 D.

Dock Machinery.

New Hydraulic Equipment for the Albert Dock, Hull. Illustrates and describes a new hydraulic 25-ton coal hoist and a 40-ton hydraulic coaling crane recently introduced. 1200 w. Engr, Lond—June 19, 1908. No. 93435 A.

Elevators.

Electric Elevators for High Buildings. John D. Ihlder. Illustrates and describes a new type of elevator, especially suited for high rises and great speeds. General discussion. 7000 w. Jour W Soc of Engrs—June, 1908. No. 94020 D.

See also Garages, under AUTOMOBILES.

Escalators.

A Moving Stairway in the Quai d'Orsay Station (Installation d'un Escalier à Marches Mobiles dans la Gare du Quai d'Orsay). Ch. Jullien. Illustrated description of the mechanism. Plates. 2200 w. Rev Gen d Chemins de Fer—June, 1908. No. 93616 G.

MISCELLANY.

Aeronautics.

Flying Machines for Warfare. Editorial discussion of their value, concluding that it is exceedingly doubtful. 1500 w. Eng News—July 30, 1908. No. 94045.

First Successful Flights of Bleriot's No. 8 Monoplane. Brief illustrated account. 500 w. Sci Am—July 18, 1908. No. 93800.

Experiments with a Helicopter. Otto G. Luyties. An illustrated description of experiments made to collect data for the construction of rotary flying machines. 2000 w. Sci Am—July 11, 1908. No. 93598.

Helicopter and Aeroplane. Otto G. Luyties. Aims to present the advantages of rotary machines, and to show the mechanical efficiency is higher than that of the aeroplane. 3500 w. Sci Am Sup—July 11, 1908. No. 93701.

The Speed of an Aeroplane. Dr. A. F. Zahm. Explains how it may be determined. 1000 w. Sci Am Sup—July 18, 1908. No. 93803.

The "June Bug" Aeroplane—A Competitor for the Scientific American Trophy. Brief illustrated description of the third aeroplane of Dr. Bell's Aerial Experiment Association. 800 w. Sci Am—July 4, 1908. No. 93489.

The Winning Flight of the "June Bug" Aeroplane for the Scientific American Trophy. An illustrated account of the recent competition and the successful flight made by Glenn H. Curtiss. 1200 w. Sci Am—July 18, 1908. No. 93801.

The Soaring Flight of Birds Attained Mechanically. Jacques Boyer. Explains the solution of the problem as shown by Prof. Marcell Deprez. Ills. 1000 w. Sci Am—July 25, 1908. No. 93928.

Flying Machines and Dirigible Balloons (Flugmaschinen und Lenkballons). Herr Hildebrandt. A general review of progress in aeronautics. Ills. 3500 w. Serial, 1st part. Glasers Ann—June 1, 1908. No. 93656 D.

Dirigible Aerostats (Les Aérostats dirigeables). Paul Renard. The first part of the serial gives a general discussion of the problem of controlling the direction of flight. Ills. Serial. 1st part. 15000 w. Rev Gen Sci—June 15, 1908. No. 93618 D.

Progress in Aeronautics, Particularly the Construction of Air Ships (Fortschitte in der Luftschiffahrt, insbesondere

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im Luftschiffbau). Hermann W. L. Moedebeck. A review of recent developments. Ills. 3000 w. Zeitschr d Ver Deutscher Ing—June 6, 1908. No. 93681 D.

Aeroplanes, Screw and Wing Machines (Drachen-, Schrauben- oder Schwingenflieger). Ansbert Vorreiter. Illustrates and describes the designs and discusses the performances, of various aeroplanes. 5000 w. Zeitschr d Mit Motorwagen-Ver—June 15, 1908. No. 93673 D.

Agricultural Machinery.

The Royal Agricultural Society's Show. Illustrates and describes the exhibits. 5000 w. Engng—July 3, 1908. Serial. 1st part. No. 93732 A.

Gyroscopes.

Some Interesting Features Concerning Gyroscopes. George T. Hanchett. On the law of gyroscopic action and its applications. 1200 w. Elec Wld—July 18, 1908. No. 93777.

MINING AND METALLURGY

COAL AND COKE.

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A New Machine for Use in Room-and-Pillar Work. Illustrated description of the Jeffrey Shortwall Machine. 900 w. Eng & Min Jour—July 4, 1908. No. 93543.

Electrical Coal-Cutting Machines. F. W. Hurd. Presents the advantages claimed, illustrating and describing well-known coal cutters. 9500 w. Elect'n, Lond—July 10, 1908. No. 93871 A.

Coke Ovens.

An Improved German Coke Oven System. A description of the von Bauer type, which avoids reversals in currents and the use of large regenerative chambers. Ills. 3000 w. Ir Trd Rev—July 30, 1908. No. 94051.

Electric Power.

Is the Electric Current Safe in Coal Mines? Rush N. Hosler. Read before the Y. M. C. A. Dist. Min. Inst. Shows the results of investigations in Europe, and discusses the dangers. 3000 w. Eng & Min Jour—July 4, 1908. No. 93545.

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Explosions.

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Recent Mine Explosions and Their Lessons. Thomas K. Adams. Read before the Coal Min. Inst. of America. Deals with the Naomi, the Monongah, and Darr explosions and their probable causes. 6500 w. Ind Wld—July 27, 1908. No. 93959.

The Ignition of Fire-damp by Sparks Struck from Rock and the Influence of Free Hydrogen on Mine Gases (Ueber die Entzündlichkeit der Schlagwetter durch Stahl und Steinfunken und den Einfluss des freien Wasserstoffes auf die Grubengase). L. Volf. 2700 w. Oest Zeitschr f Berg- u Huttenwesen—June 27, 1908. No. 93640 D.

Explosives.

Government Tests of Mine Explosions. An account of an experimental station to be erected in the United States for the testing of explosives used in coal mines. Ills. 2500 w. Sci Am—July 11, 1908. No. 93599.

The Use of Explosives in Collieries. William Maurice. Improvements in explosives and the determining factors in the ignition of firedamp are discussed, and blasting in the presence of coal dust. 2200 w. Elect'n, Lond—July 10, 1908. No. 93878 A.

Formation.

The Origin of Coal. H. M. Chance. Discusses some of the fallacies of accepted theories. 2000 w. Eng & Min Jour—July 4, 1908. No. 93544.

Mine Fires.

Fighting Fire in an Anthracite Coal Mine. P. H. Devers. An account of problems met in fighting a mine fire in the Wyoming Valley, Penn. 3500 w. Eng & Min Jour—July 11, 1908. No. 93715.

Ignition Points of Wood and Coal. Henry Hall. Brief discussion on the question of what heat is required to set wood or coal on fire, reporting tests. 1800 w. Col Guard—July 10, 1908. No. 93886 A.

Mine Locomotives.

Tests of a Benzine Locomotive Motor in Fire Damp and Protective Devices Against Danger of Fire and Explosion in the Use of Such Motors (Versuche mit einem Benzinlokomotivmotor in Schlagwettern und Erprobung von Schutzvorrichtungen gegen die Feuers- und Explo-

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sionsgefahr beim Betriebe solcher Motoren). Herr Beyling. Ills. 4200 w. Glückauf—June 13, 1908. No. 93644 D.

Mine Management.

The Supervision of Mine Workers and Means for Ensuring Eight Hours of Actual Work (Einrichtung zur Ueberwachung der Arbeiter in der Grube und Kontrollmassnahmen zur Gewährleistung einer achtstündigen Ruhezeit). F. Baum. Describes the methods of superintendence in vogue at several German collieries. Ills. 3500 w. Glückauf—June 20, 1908. No. 93645 D.

Mining.

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Coal Mining by the Retreating Room-and-Pillar System. Harvey J. Nelms. Plan of development with description. 800 w. Eng & Min Jour—July 4, 1908. No. 93541.

A Method for Working a Thick Coal Seam. Granville Poole. Describes the difficulties, and method of working under unfavorable conditions. 1500 w. Eng & Min Jour—July 4, 1908. No. 93540.

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Mining Legislation.

Protection of Mines and Miners. James C. Beebe. Aims to give an idea of what is necessary in the way of legislation to protect the lives of the men and the property of the operator. 4000 w. Mines & Min—July, 1908. No. 93517 C.

Missouri.

Coal Mining Methods in Randolph County, Mo. J. J. Rutledge. Describes the deposits and details of methods of working. Ills. 1800 w. Eng & Min Jour—July 4, 1908. No. 93539.

Peat.

Electricity from Peat Gas. An illustrated account of a scheme being projected in Ireland. 1500 w. Sci Am Sup—July 25, 1908. No. 93929.

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Rescue Appliances.

Requirements of a Breathing-Apparatus for Use in Mines. Walter E. Mingramm. Illustrates and describes the Draeger apparatus, and its use. 2000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94029 C.

The Rescue Brigade and Service Wagon of the Hibernia Company (Truppe und Gerätewagen der Bergwerksgesellschaft Hibernia für den Rettungsdienst). F. Hajemann. Gives very detailed lists of the tools, chemicals, and appliances kept on hand. Ills. 2100 w. Glückauf—June 6, 1908. No. 93643 D.

The Combined Volunteer Fire and Rescue Brigade of the Rheinpreussen Mine at Homberg (Die vereinigte Berufsfeuerwehr und freiwillige Rettungstruppe der Zeche Rheinpreussen bei Homberg a. Rhein). O. Dobbelstein. Describes the organization, station and appliances, giving the cost. Ills. 2200 w. Glückauf—June 6, 1908. No. 93642 D.

The Central Rescue Station at Beuthen, Upper Silesia, and the Development of Rescue Methods in this District (Die Zentralstelle für Grubenrettungswesen in Beuthen O. S. mit besonderer Berücksichtigung der Entwicklung des Grubenrettungswesens im oberschlesischen Industriebezirk). Herr Mandel. Describes the station, organization, rescue apparatus, training methods, etc. Ills. 4200 w. Glückauf—June 6, 1908. No. 93641 D.

Screening.

New Screening Plant at Crigglestone Collieries. Illustrated description of a new installation at these English collieries. 1500 w. Ir & Coal Trds Rev—July 3, 1908. No. 93736 A.

COPPER.

Alloys.

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Bolivia.

Some Special Features of Practice at the Corocoro Copper Mines, Bolivia. G. Preumont. Explains the use of dry-wall masonry for underground mining works, and other unusual practices due to the absence of timber and of mineral fuel. 1500 w. Min Jour—June 20, 1908. No. 93423 A.

Costs.

The Cost of Producing Copper in Arizona. James Ralph Finlay. Shows low costs in chief districts due to richness of ore. 1500 w. Eng & Min Jour—July 4, 1908. No. 93547.

Cost of Producing the World's Supply of Copper. James Ralph Finlay. Divides the mines into three classes, and compares the costs per pound of metal for each class. 4000 w. Eng & Min Jour—July 25, 1908. No. 93951.

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Idaho.
See same title, under GOLD AND SILVER.

Mexico.
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Montana.
Extensions of the Butte Copper Camp. Horace J. Stevens. Information concerning the Butte and Buxton tract. 1500 w. Min Jour—July 11, 1908. No. 93884 A.

Production
The World's Copper Supplies in 1907. John B. C. Kershaw. Gives the present state of the copper-producing industry in various parts of the world, and reviews its past growth and fluctuations. 1200 w. Cassier's Mag—July, 1908. No. 93442 B.

Queensland.
The Many Peaks Mine. J. Bowie Wilson. An account of this copper mine which has recently come into prominence. 2500 w. Aust Min Stand—June 3, 1908. No. 93552 B.

Smelter Contracts.
Ore Contracts from the Smelter's Standpoint. Clarence A. Grabill. Shows that smelting involves many items of cost which cannot be apportioned under a flat rate. 4500 w. Eng & Min Jour—July 11, 1908. No. 93712.

Smelter Smoke.
Smoke in Smelting Works. E. H. Messiter. A discussion of the causes, and methods of disposing of it. 1600 w. Min & Sci Pr—July 4, 1908. No. 93581.

GOLD AND SILVER.

Alaska.
Mining the Treadwell Lode. T. A. Rickard. An account of the methods adopted in the mining of wide ore bodies without the aid of timbers. An unusually large low-grade deposit of gold ore. Ills. 2000 w. Min & Sci Pr—July 18, 1908. No. 93903.

Australia.
See Tellurium, under MINOR MINERALS; and Zinc Milling, under ORE DRESSING AND CONCENTRATION.

Cobalt.
Cobalt, Ontario. H. B. Smith. An illustrated article describing methods of prospecting, mining, etc. 1200 w. Min & Sci Pr—June 27, 1908. No. 93499.

Ores and Rocks of the Cobalt Region. R. E. Hore. Gives results of field and laboratory study. 1800 w. Can Min Jour—July 1, 1908. No. 93514.

Production and Dividends of the Cobalt Mines. Alex. Gray. Information in regard to output, dividends, etc., of the various producing companies. 2200 w. Min Wld—July 18, 1908. No. 93834.

Cobalt Mines of To-day. Alexander Gray. Gives a brief account of a number of mining properties and general conclusions. Map. 3000 w. Min Jour—June 27, 1908. No. 93559 A.

See also Nickel, under MINOR MINERALS.

Colorado.
Treasure Mountain, Colorado. C. W. Purington. Interesting description of the characteristics of the quartz-filled veins in the Silverton region. Ills. 2500 w. Min & Sci Pr—July 4, 1908. No. 93580.

See also Dredging, under GOLD AND SILVER.

Cyaniding.
Veta Colorado Cyanide Mill, Parral, Mexico. Claude T. Rice. Describes treatment by cyanidation of silicious silver ores, using fine grinding, agitation, and filtration. Ills. 2500 w. Eng & Min Jour—July 18, 1908. No. 93837.

Cyanidation in the Malay States. H. F. Lofts. An account of the plant of the Raub Pahang mine, at Raub Pahang, F. M. S. 1300 w. Jour Chem, Met & Min Soc of S Africa—May, 1908. No. 93853 E.

Dredging.
Dredging Placer Gravels at Breckenridge, Colorado. Arthur Lakes, Sr. Illustrates and describes the ground worked and the construction and operation of the dredges. 5000 w. Mines & Min—July, 1908. No. 93520 C.

Idaho.
Atlanta Gold District, Idaho. Robert N. Bell. Brief report of this district and its mines. Ills. 1000 w. Eng & Min Jour—July 25, 1908. No. 93954.

The North Side of the Coeur d'Alene District. Herbert S. Auerbach. Information concerning the deposits of lead, silver, and gold in this region of Idaho. Ills. 4000 w. Eng & Min Jour—July 11, 1908. No. 93710.

Mining in the Coeur d'Alene District, Idaho. J. P. Rowe. Map and description of this district, discussing its lead-silver and copper deposits. 2800 w. Mines & Min—July, 1908. No. 93516 C.

Mexico.
On Horseback in Western Chihuahua. Mark R. Lamb. An account of travels among mining camps where sectionalized machinery is the rule. Ills. 5000 w. Eng & Min Jour—July 25, 1908. No. 93950.

The Mines of Northwestern Altar, Sonora, Mexico. George W. Maynard. A review of the mining development and prospects. Ores of lead, silver, gold and copper. 2000 w. Eng & Min Jour—July 11, 1908. No. 93711.

El Rayo Gold Mine, Near Santa Barbara, Mex. Claude T. Rice. The veins are developed from adit levels and the ore is treated by cyanidation and zinc-dust precipitation. Ills. 2000 w. Eng & Min Jour—July 11, 1908. No. 93713.

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Mining and Transportation at Santa Eulalia. Claude T. Rice. An illustrated account of the ore deposits, mining methods and general conditions. 2500 w. Eng & Min Jour—July 4, 1908. No. 93546.

New Mexico.

The Cachiti Mining District, New Mexico. Percy E. Barbour. A low-grade gold-silver camp is described, which has a reputation for failure, but possesses many promising veins. Ills. 1500 w. Eng & Min Jour—July 25, 1908. No. 93953.

New Zealand.

The Genesis of Bendigo and Carrick Lodes, Otago, New Zealand. James Park. Describes the deposits and gives conclusions as to their origin. 1200 w. Min & Sci Pr—July 25, 1908. No. 94048.

The Tairna Goldfield (N. Z.) J. M. Bell. Describes the geography, geology, principal mines, and metallurgical treatment of the ores. 2500 w. Aust Min Stand—June 10, 1908. No. 93899 B.

Porto Rico.

Gold Mining in Porto Rico. William B. McKinlay. An interesting review of the early history of gold discovery in America. 2500 w. Min & Sci Pr—July 18, 1908. Serial. 1st part. No. 93905.

Rand.

Notes on Hand Stoping and Underground Management on the Rand. J. A. Wickes. Discusses methods of working, timbering, and organization. 2700 w. Min Jour—June 20, 1908. No. 93421 A.

Silver Refining.

The Silver Refinery of the New Addition to the Raritan Copper Works. Frank D. Easterbrooks. Outlines the process for smelting and refining, describing apparatus used. 2000 w. Elec-Chem & Met Ind—July, 1908. No. 93455 C.

South Dakota.

South Extension Homestake Mineral Formations. Francis C. Nicholas. Illustrates and describes peculiar features in the mineral formation. 2200 w. Min Wld—July 25, 1908. No. 93958.

IRON AND STEEL.

Assaying.

The Estimation of Iron and Vanadium in the Presence of One Another. Graham Edgar. Presents a successful method of estimation under stated conditions. 1300 w. Am Jour of Sci—July, 1908. No. 93450 D.

Blast-Furnace Practice.

Recent Progress and Present Problems in the Blast-Furnace Industry. John J. Porter. Lecture before the Cincinnati Sec. of the Am. Chem Soc. Deals especially with the work of the metallurgist in increasing the production and economy in fuel. 3500 w. Mech Engr—July 10, 1908. Serial. 1st part. No. 93864 A.

Briquetting.

The Briquetting of Iron Ores (Die Brikettierung der Eisenerze). R. Goebel. Discusses especially binding materials. 1500 w. Glückauf—June 20, 1908. No. 93646 D.

Chemical Engineering.

The Chemist in the Iron Trade. George Auchy. A criticism of the methods and scope of training given by the colleges for work in analytical chemistry and chemical engineering. 3000 w. Ir Age—July 2, 1908. No. 93463.

Electro-Metallurgy.

Recent Developments of the "Rjellin" and "Rochling-Rodenhauser" Electric Induction Furnaces. J. Harden. Considers the "pinch" effect of an electric current, and discusses the rapid development, during the last two years, of the electric induction furnace. 3000 w. Ir & Coal Trds Rev—June 26, 1908. No. 93569 A.

The Elimination of Sulphur in the Héroult Process (Ueber die Entschwefelung im Héroult-Verfahren). Th. Geilenkirchen. An explanation of the total elimination of sulphur in the Héroult furnace. 2600 w. Stahl u Eisen—June 17, 1908. No. 93637 D.

Ferro-Alloys.

The Manufacture and Use of Ferro Alloys. John B. Kershaw. A discussion of the methods adopted abroad in connection with the electric furnace, and notes on the properties and applications of the alloys. 4500 w. Ir Trd Rev—July 16, 1908. No. 93779.

See also Electro-Metallurgy, under ELECTRICAL ENGINEERING, ELECTRO-CHEMISTRY; and Foundry Materials, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Germany.

See Trade, under IRON AND STEEL.

Rolling Mills.

Improvements in Plate Rolling-Mills. Andrew Lamberton. Read before the Ir & St. Inst. An account of recent improvements, largely in details of machinery, which have greatly increased the capacity of mills. 2500 w. Eng News—July 2, 1908. No. 93483.

The Power Required in Rolling Steels. J. A. Knesche. Aims to show a more scientific way of determining the power required under any existing conditions, and the direction along which improvements of such method should progress. 4500 w. Ir Age—July 23, 1908. No. 93910.

Steel Works.

La Belle Iron Works Improvements. Plans and illustrated description of the new 72-in. plate and jobbing and sheet mills recently added. 3500 w. Ir Age—July 2, 1908. No. 93462.

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Trade.

The German Iron and Steel Industry. T. Good. German competition in this industry is discussed from the British viewpoint. 3000 w. Cassier's Mag—July, 1908. No. 93446 B.

Warehouses.

The Ryerson Iron and Steel Warehouses. Illustrated description of new warehouses and general office buildings in Chicago. 2200 w. Ir Age—July 9, 1908. No. 93579.

LEAD AND ZINC.

Australia.

Broken Hill Mining Industry. G. D. Delprat. Urges economy in mine development, discussing the manufacture of spelter. 2500 w. Aust Min Stand—June 10, 1908. No. 93900 B.

See also Zinc Milling, under ORE DRESSING AND CONCENTRATION.

England.

Teesdale District. H. L. Terry. An account of the efforts being made to keep alive the traditions of this lead-mining district. 2000 w. Min Jour—June 27, 1908. No. 93558 A.

Idaho.

See same title, under GOLD AND SILVER.

Lead Assaying.

Determination of Lead in Spelter and in Ores. Eric John Ericson. Describes a new method for the wet assay of lead by means of a hydrogen peroxide reaction with potassium permanganate titration. 2500 w. Eng & Min Jour—July 25, 1908. No. 93956.

Lead Smelting.

Handling Blast Furnace Bullion at the Selby Smelting Works. James C. Bennett. Drawings and description of the method used. 1500 w. Eng & Min Jour—July 11, 1908. No. 93714.

Missouri.

Mining and Milling Methods at Granby, Missouri. Evans W. Buskett. Illustrated account of the discovery of lead and zinc, and of the methods of acquiring and working the mineral land. 1500 w. Min Wld—July 11, 1908. No. 93742.

Prussia.

Lead Mining at Mechernich, Prussia. Lucius W. Mayer. Describes the deposits which occur as fine grains in flat beds of sandstone, and are mined without the use of timber. Ills. 2500 w. Eng & Min Jour—July 25, 1908. No. 93952.

MINOR MINERALS.

Asbestos.

Asbestos: Its Occurrence and Economic Value. J. S. Diller. Describes the varieties and characteristics, method of mining, etc. 2000 w. Min Wld—July 11, 1908. No. 93743.

Cement.

Cement Works at Irthlingborough. Illustrated description of the works, their equipment, and methods of manufacture. 3000 w. Engr, Lond—July 10, 1908. No. 93895 A.

See also Limestone, under MINOR MINERALS.

Diamonds.

Recovering Diamonds from the Far North. Alex Gray. Discusses a reported discovery of diamonds in Quebec. 1200 w. Min Wld—July 11, 1908. No. 93741.

Limestone.

The Constitution of Limestone for the Manufacture of Cement and Lime (Sulla Costituzione intima dei Calcari da Cemento e da Calce). Shows the necessity for careful chemical and physical tests to secure the best results. Serial. 1st part. 2700 w. Il Cemento—May, 1908. No. 93628 D.

Manganese.

The Indian Manganese Industry. Extract from the *Madras Mail*, dealing with the present position of the manganese industry. 1800 w. Min Jour—June 20, 1908. No. 93422 A.

Supplies of Manganese Ore (Zur Deckung des Bedarfes an Manganerzen). Wilhelm Venator. A review of the manganese mining industry in all parts of the world. 4900 w. Stahl u Eisen—June 17, 1908. No. 93638 D.

Nickel.

Winnings and Wastings of Canadian Minerals. Alex. Gray. Mainly a discussion of the opposition to the nickel trust, and what the question means to Cobalt. 4500 w. Min Jour—July 11, 1908. No. 93883 A.

Potassium Chloride.

Potassium Chloride of the Upeo Plateau, Chile. Julio Schneider. Describes the plateau and the deposits, and gives information of interest. 1800 w. Min Jour—July 11, 1908. No. 93880 A.

Salt.

Salt-Making by Fusion. Information concerning the process evolved by Robert Tee. 1000 w. Sci Am Sup—July 25, 1908. No. 93932.

Tellurium.

Tellurides of Kalgoorlie. Donald Clark. Notes on tellurium and its properties, compounds of tellurium, tests, etc. 2000 w.. Aust Min Stand—June 10, 1908. Serial, 1st part. No. 93901 B.

Tin.

The Mines of Montebras. Brief illustrated account of the present condition of this tin-mining district in France. 2000 w. Min Jour—July 4, 1908. No. 93729 A.

The Tin Deposits of Bolivia. Eduardo A. L. de Romaña. Brief account of the

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history, geography and geology of the region, and the characteristics of the deposits. 2000 w. Min Jour—July 11, 1908. Serial. 1st part. No. 93881 A.

The South African Tin-Deposits. William R. Rumbold. An account of three fields being developed in 1904, describing the deposits, and giving conclusions. 2000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94033 C.

See also same title, under ORE DRESSING AND CONCENTRATION.

Vanadium.

See Assaying, under IRON AND STEEL.

MINING.

Automobiles.

The Introduction of Automobiles for Mining Work (Ueber die Einführung von Kraftlastwagen in bergbauliche Betriebe). Herr Sorg. Discusses the possibility of replacing horse-drawn vehicles by automobiles for ore transport and other purposes, giving comparison of costs. Ills. 8500 w. Glückauf—June 27, 1908. No. 93647 D.

Costs.

Variations in Mining Costs. T. A. Rickard. Gives detailed data of the cost of operations at the Bunker Hill and Sullivan mine, with discussion of the record. 1500 w. Min & Sci Pr—July 4, 1908. No. 93582.

Drills.

Rules Relating to the Transvaal Stope Drill Competition, 1909. 2500 w. Jour Chem, Met & Min Soc of S Africa—May, 1908. No. 93854 E.

The Banka Prospecting Drill. E. Middleberg. Explains the principle of the drill, and describes special features of the tools. Ills. 3000 w. Min Jour—June 20, 1908. Serial. 1st part. No. 93420 A.

Electric Hoisting.

Electric Winding. T. Campbell Futers. Discusses the subject in all its bearings, the advantages, and the conditions that will render it profitable. 6000 w. Elect'n, Lond—July 10, 1908. No. 93868 A.

Energy Calculations in Coal Winding. R. Livingstone. Notes applying particularly to the Thury System, where the winding motor is supplied by a motor generator fitted with a heavy fly-wheel, though the methods for calculating the h.p. are applicable to any system. Also illustrates and describes electric winding plant. 6500 w. Elect'n, Lond—July 10, 1908. No. 93869 A.

Electric Power.

General Survey of Electric Power Applied to Mining. W. S. Taplis. Considers the use of gas engines, turbines, and power house auxiliaries, the application of motors, etc. 4800 w. Elect'n, Lond—July 10, 1908. No. 93866 A.

Employing Electric Power in Joplin District. Doss Brittain. Describes the construction and equipment of buildings of the Spring River Power Co. Ills. 1800 w. Min Wld—July 18, 1908. No. 93832.

See also same title, under COAL AND COKE; and Cables, under ELECTRICAL ENGINEERING, TRANSMISSION.

Geology.

Dip and Pitch. R. W. Raymond. A correction or explanation of Prof. Louis' definition of "pitch" as given in a previous paper. Also reply from Prof. Henry Louis. 2000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94034 C.

Haulage.

Electricity in Mine Transportation. Briefly considers the four kinds of motive power used in mines, especially the application of electricity. 2000 w. Sci Am Sup—July 25, 1908. No. 93931.

Electric Haulage in Mines. W. C. Mountain. Detailed discussion of the four systems upon which haulage in collieries is mainly effected, the power required, apparatus used, etc. Ills. 12000 w. Elect'n, Lond—July 10, 1908. No. 93870 A.

Construction of Haulage Mechanism So as to Preserve Ropes and Chains. E. Heckel, in *Stahl und Eisen*. On defects in haulage mechanism and the causes of breakage of ropes, etc. Ills. 2000 w. Col Guard—July 17, 1908. No. 93976 A.

The Preservation of the Life of Driving Ropes and Chains (Wie sollen Seil- und Kettentriebe mit Rücksicht auf die Haltbarkeit des Zugorgans construiert sein?). Discusses the stresses to which ropes and chains are subjected and the design of driving systems. Ills. 3000 w. Stahl u Eisen—June 10, 1908. No. 93635 D.

Hoisting.

See Haulage, under MINING.

Locomotives.

Development of Electric Mine Locomotive. Frank C. Perkins. On the advantages of and improvements in various types of mine locomotives. Ills. 4000 w. Min Wld—July 4, 1908. No. 93529.

See also Mine Locomotives, under COAL AND COKE.

Management.

See Rand, under GOLD AND SILVER.

Pumping.

Electric Pumping. Dr. R. Herzfeld. Reviews the development of pumping machinery for mining plants, giving reasons for favoring electrical pumping plants. Also illustrated descriptions of examples of electric pumps. 6500 w. Elect'n, Lond—July 10, 1908. No. 93867 A.

Quarrying.

The Penrhyn Quarry. Henry Briggs. Illustrates and describes the method of working and the arrangement of labor in

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the largest quarry in the world, Wales. 3000 w. Mines & Min—July, 1908. No. 93515 C.

Signalling.

Electrical Signalling in Mines. F. Hird. Considers the applications made to hauling, hoisting, etc., the principles to be observed, and gives a description of a system extensively applied in Germany and Belgium. Ills. 4000 w. Elect'n, Lond—July 10, 1908. No. 93876 A.

Stoping.

See Rand, under GOLD AND SILVER.

Surveying.

Mine Surveying. Charles W. Helmick. Suggestions helpful in surveying in mining work. 3500 w. Transit, Univ of Iowa—Vol. XIII, 1908. No. 93767 N.

Tunneling.

See Tunnels, under CIVIL ENGINEERING, CONSTRUCTION.

Valuation.

Valuation of Mining Properties. George H. Gillespie. Discusses problems of mine valuation. 2000 w. Can Min Jour—July 15, 1908. Serial, 1st part. No. 93820.

Ventilation.

Ventilation of Mines by Electric Fans. J. W. Gibson. Illustrates and describes several installations, and examples of ventilating machinery. 3500 w. Elect'n, Lond—July 10, 1908. No. 93877 A.

The Ventilation of Metalliferous Mines Henry Briggs. A letter discussing this question, especially the gaseous impurities detrimental to the health of miners. Also editorial. 4500 w. Min Jour—July 18, 1908. No. 93974 A.

ORE DRESSING AND CONCENTRATION.

Briquetting.

See same title, under IRON AND STEEL.

Copper.

Experimental Mill of the Nevada Consolidated Copper Company. M. L. Requa. Illustrated description of a small concentrating mill and the tests made to justify a large investment. Details of tests and general information. 2500 w. Min & Sci Pr—July 18, 1908. No. 93904.

Filters.

The Butters Vacuum Filter. G. Howell Clevenger. Considers the treatment of slimes, discussing pressure filters and vacuum filters, and describing the Butters filter in detail. 3000 w. Mines & Min—July, 1908. No. 93519 C.

Gold Milling.

Milling and Cyanide Practice, San Prospero Mill, Guanajuato. J. S. Butler. Describes the mill and methods of ore treatment. 1800 w. Min & Sci Pr—July 25, 1908. No. 94050.

Treatment of Gold-Ores in New Zealand, South Africa, America, and Queensland. G. E. Bray. Abstracts from paper read before the N. Queensland Min. & Mill-Mgrs.' Assn. describing recent practice in the countries named. 2300 w. N Z Mines Rec—April 16, 1908. No. 93550 B.

See also Slimes Treatment, under ORE DRESSING AND CONCENTRATION.

Magnetic Separation.

Magnetic Separation and Its Application to Roasted Siderite at Siegen (Die magnetische Aufbereitung und ihre Anwendung für gerösteten Spateisenstein im Siegerlande). Herr Horel. Ills. 3200 w. Oest Zeitschr f Berg- u Hüttenwesen—June 27, 1908. No. 93639 D.

Sampling.

Ore Sampling by Machines. John A. Church. Discusses conditions necessary to accurate sampling, suggesting improvements. 3000 w. Eng & Min Jour—July 18, 1908. No. 93836.

Silver Milling.

See Cyaniding, under GOLD AND SILVER.

Slimes.

Theory of the Settlement of Slime. H. S. Nichols. Discusses factors affecting the settlement of slimes, giving results of tests and conclusions. 1200 w. Min & Sci Pr—July 11, 1908. No. 93806.

Slimes Treatment.

The Adair-Usher Process. Alfred Adair. An account of the experiments, and the ideas which they suggested, giving diagrams showing results, describing the washing apparatus and giving notes on the assay of slimes. 6500 w. Jour Chem, Met & Min Soc of S Africa—May, 1908. No. 93852 E.

Tin.

New Methods of Concentrating Alluvial Tin. Harry D. Griffiths. An account of new methods introduced at Cape Colony, consisting in effecting a coarse concentration of the wash by means of a rotary pan, and then cleaning in a hydraulic separator to the grade required. 1200 w. Min Jour—July 11, 1908. No. 93885 A.

Tube Mills.

The Hardinge Conical Pebble-Mill. H. W. Hardinge. Illustration and information concerning this mill. 1500 w. Bul Am Inst of Min Engrs—July, 1908. No. 94031 C.

Zinc Milling.

The Metallurgy of Broken Hill. Gerard W. Williams. Describes the methods in vogue at the different mines. 3000 w. Aust Min Stand—May 27, 1908. Serial, 1st part. No. 93551 B.

Mill Construction in the Joplin District. Otto Ruhl. Discusses changes in practice due to increase in capacity, the cost of mill construction, etc. 2200 w. Eng & Min Jour—July 18, 1908. No. 93838.

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MISCELLANY.

Alloys.

The Alloys of Copper (Les Alliages de Cuivre). M. A. Portevin. Summarizes the results of Prof. Tammann's researches on the alloys of copper with gold, aluminium, bismuth, calcium, cadmium, cobalt, iron, magnesium, manganese, nickel, phosphorus, palladium, platinum, silicon, tellurium and thallium. Ills. 7500 w. Rev de Métal—June, 1908. No. 93698 E + F.

Argentina.

Natural Soda and Other Deposits of the Atacama Desert, Argentine-Chilian Andes. Dr. Fritz Reichert. Information concerning deposits of soda, sulphur, gold, alum, and pyrites. 2000 w. Min Jour—July 11, 1908. No. 93882 A.

Australasia.

Mining in Australasia in 1908. F. S. Mance. Reviews the progress of the industry and the returns of gold, silver, lead, copper, tin and zinc. 2500 w. Eng & Min Jour—July 18, 1908. No. 93840.

Australia.

Mining Prospects in Commonwealth of Australia. John Plummer. Discusses the increased cost of mining and ore treatment and the effects, considering the prospects encouraging. Ills. 1000 w. Min Wld—July 18, 1908. No. 93833.

Bolivia.

See Burma, under MISCELLANY.

Burma.

Recent Mining Wanderings in Burma, Chile, and Bolivia. J. H. Curle. An interesting account of travels through mining regions, with critical remarks on things observed. 3500 w. Min & Sci Pr—June 27, 1908. No. 93500.

Chile.

See Burma, under MISCELLANY.

Exhibitions.

The Mining Exhibition. An illustrated description of the interesting exhibits at Olympia. 32000 w. Ir & Coal Trds Rev—July 17, 1908. No. 93987 A.

The World's Great Mining Exhibition. An illustrated account of the exhibition recently opened at Olympia, the exhibits, etc. 6000 w. Col Guard—July 17, 1908. Serial, 1st part. No. 93975 A.

Great Britain.

Twenty-five Years of Mining. Edward Ashmead. A retrospective review, 1880-1904, of mining companies registered in Great Britain, with notes and comments, and the names and capitals of the principal registrations. 5800 w. Min Jour—July 4, 1908. Serial, 1st part. No. 93730 A.

Herculaneum.

The Excavation of Herculaneum by Mining Methods. Alex. Del Mar. An outline of the proposed method and its possible results. 2500 w. Engineering Magazine—Aug., 1908. No. 94011 B.

Honduras.

Some Notes on Honduras. C. F. Spalding. Information relating to the rich mineral deposits, the conditions, etc. 1200 w. Min Wld—July 4, 1908. No. 93530.

Korea.

The Mineral Resources of Korea. Hallet R. Robbins. An account of foreign mining enterprises, and the native methods of mining and metallurgical operations. Ills. 4000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94032 C.

Ore Deposits.

Rock Oxidation at Cripple Creek. Philip Argall. Description of the volcanic action and rock oxidation on Globe hill. 3300 w. Min & Sci Pr—June 27, 1908. No. 93501.

Waters, Meteoric and Magmatic. T. A. Rickard. Discusses the effect of ground-water on ore deposition. 3000 w. Min & Sci Pr—June 27, 1908. No. 93498.

Peru.

The Physical Features and Mining Industry of Peru. George I. Adams. Describes the physical and climatic divisions, the commercial features, etc. Maps. 3000 w. Bul Am Inst of Min Engrs—July, 1908. No. 94030 C.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Derailments.

The Wreck of the White Mountain Express. Editorial criticism of the design of electric locomotives, claiming this to be the cause of this wreck. 1000 w. Sci Am—July 25, 1908. No. 93925.

Signals.

A. H. Johnson's Electric Switch and Signal Apparatus. Guy W. Wyles. Illustrated description of a system of electric interlocking. 1500 w. R R Age Gaz—July 10, 1908. No. 93745.

Automatic Block Signals on the Long Island. Diagrams and description of recently installed signals between Glendale Junction and Jamaica. 800 w. R R Age Gaz—July 17, 1908. No. 93829.

Electric Signaling at the New Victoria Station, London. Illustrated description

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of signaling carried out on the Sykes Electro-Mechanical System. 2500 w. Elect'n, Lond—July 17, 1908. No. 93966 A.

The Storage Battery in Signal Service.—Restoration of Low Cells. H. M. Beck. Discusses the mechanical and electrical restoration of the cells, the impurities in the electrolyte, and the determination of the cause of trouble. 3500 w. Jour Ry Sig Assn—July, 1908. No. 94009 F.

Trains.

Corridor Train for South Indian Railway. Plans and description of a train, showing the requirements of service in India. 1300 w. R R Age Gaz—July 17, 1908. No. 93828.

The Maritime Express. An account of the principal express train on the Intercolonial Railway of Canada, illustrating the country through which it passes. 1200 w. Ry & Loc Engng—July, 1908. No. 93510 C.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Wrongly Used Triple Valves. Remarks on wrong applications and the effects. 700 w. Ry & Loc Engng—July, 1908. No. 93511 C.

Car Heating.

Ventilating and Heating of Coaches and Sleeping Cars. From the report of a committee to the Master Car Bldrs.' Assn. Outlines the various systems used and describes the present standard arrangements of the Pennsylvania R. R., the Pullman system, and others, discussing proposed improvements. Ills. 8500 w. Ry & Engng Rev—July 18, 1908. Serial, 1st part. No. 93835.

Cars.

New Rolling Stock, Shanghai-Nankin Railroad. Illustrates and describes luxurious new cars built in England. 1600 w. R R Age Gaz—July 17, 1908. No. 93824.

See also Trains, under CONDUCTING TRANSPORTATION.

Car Ventilation.

See Car Heating, under MOTIVE POWER AND EQUIPMENT.

Draft-Gear.

Draft Rigging. Editorial review of opinions set forth in recent papers regarding the proper methods to be pursued to relieve the car shock. 1500 w. R R Age Gaz—July 24, 1908. No. 93934.

Electrification.

Railway Electrification Plans on the Continent. Editorial review of what is being done in the various countries. 2500 w. Engng—July 17, 1908. No. 93984 A.

Locomotives.

American Locomotives for Export. Illustrates and describes types sent to many different countries. 2000 w. Engr, Lond—June 26, 1908. No. 93567 A.

Recent American Ten-Wheeled Locomotives. Illustrated detailed description of three recent types of 4-6-0 engines. 3000 w. Mech Engr—July 3, 1908. No. 93724 A.

Prairie Locomotive for the Wabash. Illustrated detailed description of 2-6-2 locomotives intended for freight service. 1200 w. R R Age Gaz—July 17, 1908. No. 93830.

Ten-Wheel, Oil-Burning Locomotive for the Southern Pacific Co. Illustrated description. 800 w. Ry & Engng Rev—July 25, 1908. No. 93960.

Consolidation Locomotive; Chesapeake & Ohio. Illustrated description of engines used for hauling coal trains. 300 w. R R Age Gaz—July 31, 1908. No. 94057.

Consolidation Locomotive for the Southern Railway. Illustrated description of engines for fast freight service. 600 w. Ry & Engng Rev—July 11, 1908. No. 93740.

Four-Coupled Eight-Wheeled Side-Tank Locomotive; Egyptian Delta Light Railways, Ltd. Illustrated detailed description. Plate. 500 w. Engng—July 10, 1908. No. 93890 A.

New Pacific Type Locomotive—Western Railway of France. Illustrated detailed description of engines designed for hauling heavy and fast trains. Plate. 3000 w. Engr, Lond—July 17, 1908. No. 93977 A.

The British Locomotive. A. W. S. Graeme. From a paper before the Rugby Engng. Soc. Describes British practice and its adaptation to the requirements, giving British views on compounding. 5000 w. R R Age Gaz—July 17, 1908. No. 93825.

An Abt Rack Locomotive for the Transandine Railroad. Photographs and drawings, with description of engines for steep grades. 1500 w. R R Age Gaz—July 10, 1908. No. 93746.

Mallet Type Articulated Locomotives. Grafton Greenough. An interesting illustrated discussion of the development of this type, reviewing the better known designs of double truck and articulated locomotives. General discussion. 7000 w. Pro Engrs' Club of Phila—April, 1908. No. 94004 D.

Twelve-Wheel Mallet-Compound Locomotive; Central Railway of Brazil. Illustrated description of engines built by the American Locomotive Co. 1000 w. Engng—June 19, 1908. No. 93428 A.

Locomotive Trucks.

Evolution of the Locomotive Truck. S. A. Bullock. Historical review, with illustrations. 2500 w. R R Age Gaz—July 24, 1908. No. 93936.

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Motor Cars.

A Steam Motor Car: Chicago, Rock Island & Pacific R. R. Illustrated description of a 250 H.P., oil-burning, compound, steam motor car. 1500 w. Eng News—July 16, 1908. No. 93792.

Rail Motor Cars in Wisconsin. Reports the case of Colin W. Wright vs. Illinois Central R. R. Co. before the Railroad Commission of Wisconsin, the complaint in which alleged inadequacy of passenger service. 2000 w. R R Age Gaz—July 24, 1908. No. 93938.

Refrigeration.

The Absorption Machine in Railroad Refrigeration. Joseph H. Hart. Discusses the application of refrigeration to railroad work and the advantages of the absorption system. 2800 w. R R Age Gaz—July 31, 1908. No. 94056.

Springs.

Experimental Determination of the Coefficient of Friction of Spring Plates (La Determination expérimentale du Coefficient de Frottement des Lames de Ressorts). M. Hallard. Describes the method employed and gives the results. Ills. 2200 w. Rev Gen d Chemins de Fer—June, 1908. No. 93617 G.

Stores Keeping.

Economical Care of Material. Frank H. Crump. Explains a practical and efficient system that has been thoroughly tested. 1500 w. R R Age Gaz—July 24, 1908. No. 93935.

Superheating.

The Use of Superheated Steam in Locomotives. Dr. Wilhelm Schmidt. Shows what can be gained by the use of superheated steam, and the rules that govern the design of an economical locomotive superheater. 3000 w. R R Age Gaz—July 17, 1908. Serial, 1st part. No. 93822.

Train Lighting.

The Electric Train-Lighting System of the Gesellschaft für Zugbeleuchtung. Illustrates and describes this system of a Berlin company. 4000 w. Engng—June 26, 1908. No. 93563 A.

PERMANENT WAY AND BUILDINGS.

Crossings.

Road, Canal, and Rail; Joint Crossing. W. B. Paley. Illustrates and describes Windmill Lane bridge, in England, where a highroad, a canal, and a railroad cross at the same point. 700 w. R R Age Gaz—July 17, 1908. No. 93827.

Abolishment of Grade Crossings on the Philadelphia & Reading Railway in Philadelphia. Brief illustrated description of the work. 1200 w. Eng Rec—July 11, 1908. No. 93708.

Elevated Railroads.

Philadelphia Track Elevation of the Reading. Illustrates and describes proposed work. 1000 w. R R Age Gaz—July 31, 1908. No. 94055.

Freight Sheds.

See Yards, under PERMANENT WAY AND BUILDINGS.

Rails.

The Latest Results with Steel Rails. E. F. Kenney. Report of results of investigations by Pennsylvania Railroad interests. 2500 w. Ir Age—July 2, 1908. No. 93464.

Some Features of the Present Steel-Rail Situation. Charles B. Dudley. Presidential address before the American Society for Testing Materials. 7500 w. Eng News—July 2, 1908. No. 93841.

A Microscopic Investigation of Broken Steel Rails: Manganese Sulphide as a Source of Danger. Henry Fay. Read before the Am. Soc. for Test. Materials. Reports results of investigations made of broken rails from various sources. Ills. 4000 w. Eng News—July 23, 1908. No. 93946.

Reconstruction.

Double-Tracking of the Southern Railway Between Greensboro and Spencer, N. C. George H. Gilbert. Illustrated detailed description of the work. 2500 w. Eng Rec—July 4, 1908. No. 93527.

Switches.

See Signals, under CONDUCTING TRANSPORTATION.

Ties.

Novel Design of Steel Tie and Railway Appliances. Information concerning a design to be tested by the Pennsylvania R. R. Co. Ills. 1500 w. Ir Trd Rev—July 16, 1908. No. 93780.

Track Construction.

The Theory and Construction of the Railways of the Future (Théorie et Pratique des Voies ferrées futures). L. Schlüssel. Discusses the need for greater solidity and rigidity of track construction and means of securing them. Ills. 10500 w. Mem Soc Ing Civ de France—Mar., 1908. No. 93604 G.

Train Sheds.

Removing the Grand Central Train Shed. Brief illustrated description of methods used in removing this large shed in New York City. 500 w. R R Age Gaz—July 31, 1908. No. 94058.

Yards.

New Goods Yard and Warehouse at Glasgow. Plans and illustrated description of extensive improvements by the North British Ry. Co. 4000 w. Engr, Lond—June 26, 1908. No. 93566 A.

TRAFFIC.

Bills of Lading.

Uniform Bill of Lading. Discusses the bill recommended for adoption, Septem-

ber 1 next, by the Interstate Commerce Commission. 2500 w. R R Age Gaz—July 17, 1908. No. 93831.

Demurrage.

The Hay Traffic in New York City Freight Yards. Gives the decision of the Interstate Commerce Commission concerning demurrage rates on car loads of hay, with details of this business in New York City. 2000 w. R R Age Gaz—July 17, 1908. No. 93826.

Freight Rates.

W. C. Brown on Proposed Rate Increase. An argument for the general increase of freight rates. 2300 w. R R Age Gaz—July 17, 1908. No. 93823.

STREET AND ELECTRIC RAILWAYS

Adhesion System.

See Switzerland, under STREET AND ELECTRIC RAILWAYS.

Car Records.

The Car Defect Record System of the Elevated Division, Boston Elevated Railway Company. Describes the system of defect records adapted to the handling of heavy traffic by multiple-unit trains. 2000 w. Elec Ry Jour—July 18, 1908. No. 93805.

Conductors.

Track Return. E. Goolding. Considers the conditions influencing the drop in volts on track rails. 2000 w. Tram & Ry Wld—July 2, 1908. No. 93856 B.

Hamburg.

The History of the Establishment of the Hamburg City and Suburban Railways (Zur Entstehungsgeschichte der Stadt- und Vorortbahnen in Hamburg). Ed. Vermehren. Reviews the various projects which have culminated in the present extensive construction. 2500 w. Glasers Ann—June 1, 1908. No. 93601 D.

History.

Tramways of the World. Sir J. Clifton Robinson. Slightly condensed address before the Tram & Light Ry's Assn. Gives a résumé of the early days of tramway enterprise, British electric tramways, etc. 4500 w. Elec Engng—July 16, 1908. No. 93969 A.

Instruction Schools.

Chicago City Railway School of Instruction. An illustrated description of the equipment and course of instruction. 2200 w. Elec Ry Jour—July 18, 1908. No. 93804.

Locomotives.

Single-Phase Locomotive of the Windsor, Essex & Lake Shore Railway of Canada. S. C. Dewitt. Illustrated description of a locomotive built for pulling gravel cars for ballasting, handling general freight, and handling excursion trains. 1200 w. Elec Ry Jour—July 25, 1908. No. 93902.

The Fireless Locomotive. Illustrated description of a German storage battery locomotive used for switching service. 600 w. R R Age Gaz—July 10, 1908. No. 93744.

The Storage-Battery Switching Locomotive in the Yards of the Imperial Railroad Shops at Tempelhof, near Berlin (Die Akkumulatoren - Verschiebelokomotive der Königlichen Eisenbahn-Werkstätten-Inspektion in Tempelhof bei Berlin). Alfred Strauss. Illustrated description. Serial, 1st part. 1200 w. Elektrotech Zeitschr—June 25, 1908. No. 93695 D.

See also Derailments, under RAILWAY ENGINEERING, CONDUCTING TRANSPORTATION.

London.

The Metropolitan Electric Tramways. Illustrates and describes an extensive system in the northern part of London. 4500 w. Tram & Ry Wld—July 2, 1908. No. 93855 B.

Rack Railways.

See Switzerland, under STREET AND ELECTRIC RAILWAYS.

Rail Corrugation.

Rail Corrugation. C. A. Carus-Wilson. Lecture before the Tram. Cong. An investigation of the causes. 3000 w. Engng—July 17, 1908. No. 93986 A.

Preliminary Report on Rail Corrugation (Voorloopig Rapport betreffende de Golfslijlage der Rails). A report of investigations made by a committee of the Royal Institute of Engineers of Holland. Ills. 2500 w. De Ingenieur—June 6, 1908. No. 93696 D.

Rail Joints.

Tramway Rail Joints. Alfred H. Gibbings. Read before the Tram. & Light Rys. Assn. The ordinary concrete track used in England is discussed with special reference to types of joints. Discussion. Ills. 5400 w. Elec Engng—July 16, 1908. No. 93970 A.

Shops.

Special Tools at the Shops of the Chicago City Railway Company. Brief illustrated descriptions of devices for facilitating repair work. 2500 w. Elec Ry Jour—July 11, 1908. No. 93583.

We supply copies of these articles. See page 982.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated: W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin du Lab. d'Essais. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Clay Record. *s-m.* Chicago.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.

Camptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electric Railway Review. *w.* Chicago.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *w.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Men. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereines für die Fôrderung des Local und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *b-m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Public Works. *qr.* London.
Quarry *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Age Gazette. *w.* New York.
Railway & Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista Tech. Ind. *m.* Barcelona.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Rivista Gen. d Ferrovie *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Street Railway Journal. *w.* New York.
Surveyor *w.* London.
Technology Quarterly. *qr.* Boston, U. S. A.
Technik und Wirtschaft. *m.* Berlin.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagon Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

BOOKS RECEIVED.

Autogenous Welding of Metals. By L. L. Bernier. Size, 6½ by 4½ in.; pp., 45. Ills. Price, $1. New York: The Boiler Maker.

Bulletins 9 to 17, University of Illinois, Engineering Experiment Station. Size, 9 by 6 in. Ills. Urbana, Ill.: University of Illinois.

Forest Products of the United States, 1906. Size, 9 by 6 in.; pp., 99. Washington, D. C.: United States Department of Agriculture.

Conversations on Electricity. By Joseph G. Branch. 8 by 5½ in.; pp., 282. Ills. Price, $2. Chicago and New York: Rand, McNally & Company.

Main Sewerage and Sewage Disposal. By T. Aird Murray. Size, 9 by 6 in.; pp., 46. Ills. Price, 25 cents. Toronto, Ont.: The Canadian Engineer.

Report of the Commissioner of Public Roads, State of New Jersey, 1907. Size, 9 by 6 in.; pp., 209. Ills. Trenton, N. J.: Commissioner of Roads.

Annual Report of the City Engineer of the City of Halifax, N. S., for the Civic Year 1905-6. Size, 8½ by 6 in.; pp., 203. Halifax, N. S.: City Works Department.

General Index to Reports, 1885-1906, Geological Survey of Canada. Compiled by F. J. Nicolas. Size, 9½ by 6½ in.; pp., 1014. Ottawa, Canada: Geological Survey.

Sixteenth Annual Report of the Sewerage and Water Board of New Orleans. Size, 9 by 6 in.; pp., 61. Ills. Maps. New Orleans, La.: Sewerage and Water Board.

Report of the United States Fuel-Testing Plant, at St. Louis, Mo., January 1, 1906, to June 30, 1907. Size, 9 by 6 in.; pp., 299. Washington, D. C.: United States Geological Survey.

Report of the State Engineer and Surveyor, State of New York, 1906. Two Volumes. Size, 9 by 6 in.; pp., 555, 378. Ills. Albany, N. Y.: Office of the State Engineer and Surveyor.

Physical Geography of the Evanston-Waukegon Region. By Wallace A. Atwood and James Walter Goldthwait. Size, 9 by 6 in.; pp., 104. Ills. Urbana, Ill.: State Geological Survey.

A Vest-Pocket Handbook of Mathematics for Engineers. By L. A. Waterbury. Size, 5½ by 3 in.; pp., 91. Ills. Price, $1, 4/6. New York: John Wiley and Sons; London: Chapman & Hall, Ltd.

Diamond Bars for Concrete-Steel Construction: Reasons and Rules for Proper Design. By Edwin Thacher. Size, 9 by 6 in.; pp., 4. Ills. Price, $1. New York: Concrete-Steel Engineering Company.

The Standard Handbook for Electrical Engineers. Written and Compiled by a Staff of Specialists. Second Edition. Size, 6¾ by 4 in.; pp., 1285. Ills. Price, $4. New York: McGraw Publishing Company.

Organization, Equipment and Operation of the Structural-Materials Testing Laboratories at St. Louis, Mo. By Richard L. Humphrey and Joseph A. Holmes. Size, 9 by 6 in.; pp., 84. Ills. Washington, D. C.: United States Geological Survey.

Slow Burning or Mill Construction. Report No. V, Insurance Engineering Experiment Station. Third Edition. Size, 11 by 9 in.; pp., 28. Ills. Plates, 9. Price, 25 cents. Boston, Mass.: Boston Manufacturers' Mutual Fire Insurance Co.

Proceedings of the Seventeenth Annual Convention of the Association of Railway Superintendents of Bridges and Buildings held in Milwaukee, Wis., October 15, 16, and 17, 1907. Size, 9 by 6 in.; pp., 316. Ills. Concord, N. H.: Secretary of the Association.

Accidents, Their Causes and Remedies. A Treatise of the Development of Care and Faithfulness to Aid the Safeguarding of Life and Property. By Thomas D. West. Size, 7¾ by 5½ in.; pp., 95. Ills. Price, 25 cents. Greenville, Pa.: Beaver Printing Co.

Annual Report of the Minister of Mines for the Year Ending 31st December, 1907, being an Account of Mining Operations for Gold, Coal, etc., in the Province of British Columbia. Size, 10½ by 7½ in.; pp., 235. Ills. Maps. Victoria, B. C.: Department of Mines.

Stationary Engineering. By Joseph G. Branch. In Three Volumes: Vol. I, Steam Boilers and Attachments; Vol. II, Steam Engines, Heating and Electricity; Vol. III, Mechanical Refrigeration, Elevators and Steam Turbines. Size, 8 by 5½ in.; pp., 393, 376, 267. Ills. Price, $7; each volume, $2.50. New York and Chicago: Rand, McNally and Company.

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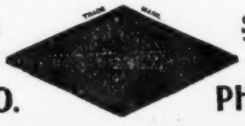

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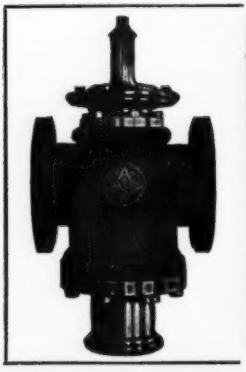

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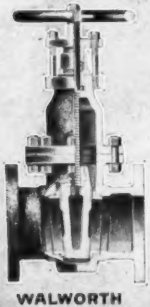

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AUTHORS AND PAPERS FOR SEPTEMBER, 1908.

H. VON SCHON *(The Use and Conservation of Water-Power Resources)*—Born in Germany, graduating from Berlin in 1869; for thirty years a specialist in hydraulic engineering; several years were spent by him in connection with the U. S. Engineer Corps in surveys of the Great Lakes, but for the last twelve years he has devoted himself exclusively to the designing of hydro-electric power installations. The most important of the many he has planned is that at the foot of Lake Superior, notable as utilizing the largest flow—some 30,000 second feet—while that at Eugenia Falls, Ontario, uses only 80 second feet, but a head of 400 feet. Mr. von Schon has originated a number of valuable features, one of which, the submerged power house, has been incorporated recently in a plant at Patapsco, Md., the entire generating equipment being placed in the interior of the dam, with the spillway water rolling over the power-house roof. He is a member of the American Society of Civil Engineers.

F. E. WEBNER *(Obtaining Actual Knowledge of the Costs of Production)*—1889-90, attended Armour Institute, Chicago, in mechanical studies; 1892, embarked as public accountant, specializing in factory accounting; 1895, served with S. T. Williams as factory and business economist, later resuming under his own name and various firm styles in Chicago and branch offices; in 1897 merged his Chicago office with the Account Audit & Assurance Co. of New York and worked in connection with the late A. O. Kittredge, C. P. A.; later removed to New York and went thence to many parts of the United States on installations of factory cost systems; after Mr. Kittredge's death removed to Cincinnati to install a factory cost system in the Globe-Wernicke plant, and there established acquaintance with many machine-tool and other manufacturers, leading to his establishment of headquarters in that city and extension of his business activities thence in all directions.

PERCIVAL ROBERT MOSES *(Storage Batteries. Their Construction and Use)*—Born in New York; educated in Europe and in the United States; entered the School of Mines of Columbia College in 1891 and graduated in 1895-6 with the degree of Electrical Engineer; was for some time with the Sprague Electrical Company in factory and construction work; practising as consulting engineer in New York since 1898; member of the American Institute of Electrical Engineers.

A. SELWYN-BROWN *(Modern Developments in the Metallurgy of Lead and Zinc)*—Born Sydney, N. S. W.; graduated in civil and mechanical engineering at University College, London, and in arts, science, and law at New York University; studied chemistry and metallurgy with Sir William Ramsay, and mining engineering at various mines and works in England and Scotland; has had the management of large mining and engineering works in the United States, Canada, and elsewhere, and was one of the pioneers in the Tonopah and southern Nevada fields; his experience in tin mining has been extensive, and he has held the management of tin mines in Tasmania and several of the Australian states. Now consulting engineer in New York and lecturer on mining at the New York University, in the department of Commerce, Accounts and Finance.

C. H. STILSON *(Manufacturing from Stock. A Profitable Policy)*—Was graduated from Sheffield Scientific School in electrical engineering in 1897, and spent a year in practical work; was connected with the O. S. Walker Co., Worcester, Mass., and later with the Westinghouse Electric & Mfg. Co., with whom he remained until 1904 in various capacities ranging from inspector in the testing department to designing engineer and district correspondent; in 1904 entered the service of the Scovill Mfg. Co., Waterbury, Conn., as cost expert and systematizer, and has spent the intervening time in organizing their cost and order systems; at present has charge of their overhead cost department.

THOMAS L. WHITE *(Alcohol as a Fuel for Internal-Combustion Motors)*—Foundation Scholar, University Mathematical Scholar, Gabbett Prizeman and Honors Graduate (1891) in mathematical and physical science of the University of Durham, England. Lecturer in mathematical and physical science to officers of the British Army studying for promotion, from 1891 to 1900. Member of the Society of Automobile Engineers and the Aero Club of America, and writer on mathematical and physical subjects. Has devoted himself during the last three years to special study of gas-engine fuels, and experiments

with alcohol in internal-combustion engines. Joint patentee with F. W. Barker of a new process for the utilization of alcohol and calcium carbide in high-speed, moderate-compression automobile engines.

CHARLES A. HOWARD *(The Feed-Water System for the Power Plant)*—Graduated from Massachusetts Institute of Technology; with the Grand Trunk Railway as shop apprentice, and afterwards as inspector of bridge material, grain elevators, etc.; conducted special work for the Boston & Maine Railroad in finding the live loads on locomotive driving springs; now assistant engineer, New York Edison Co.; junior, American Society of Mechanical Engineers.

WERNER BOECKLIN *(The Coal-Handling Industry of Greater New York)*—Graduated 1891 from the School of Mines, Columbia Universtiy, with the degree of Civil Engineer; was engaged with Heyl & Patterson, Robins Conveying Belt Co., and John A. Mead & Co. as engineer in charge of the design of a number of important material-handling equipments, and with W. S. Barstow & Co., as engineer in charge of erection of a large steel-car plant and other works; at present associated with Percival Robert Moses as consulting engineer; member of the American Society of Civil Engineers and of the New York Railroad Club.

JOHN GEO. NIEDERER *(A Superintendent's Views of American Shop and Labor Conditions)*—Born New York city, 1855; educated in public day and night schools and private school; went to work at 13, and after four years in various offices was apprenticed to Tiffany & Co. to learn the trade of turning and spinning metals; while so engaged studied mechanical and ornamental drawing, modeling and pattern making, and developed designs for a new machine gun; after serving his apprenticeship, worked as journeyman, foreman, inspector and superintendent in various establishments, occupied chiefly with modern methods for ornamental working of the non-ferrous metals; held positions as foreman with S. Kirk & Sons, and the Baltimore Safety Lamp Co., and as superintendent with S. Klaber & Co., Commercial Typewriter Co., De Kosenko Bronze Co., Sterling Fronze Co., Penna. Bronze Co., and the Autocycle Co.

HARRINGTON EMERSON *(Efficiency as a Basis for Operation and Wages)*—Born in Trenton, New Jersey, 1853. Educated in Europe, receiving the degree of M. A. at the Royal Polytechnic at Munich, Bavaria; professor at the State University of Nebraska, 1875; engaged in engineering work on the Burlington & Missouri R. R. in 1886, and later engaged in making many inspections and preparing reports on important engineering and mining work in the United States, Mexico and Alaska. Recently directed the widely celebrated reorganization and betterment work on the Santa Fe system; associated with the American Locomotive Company in a similar capacity; originated and developed the efficiency system of wage payment. Consulting engineer, the Emerson Company, New York City.

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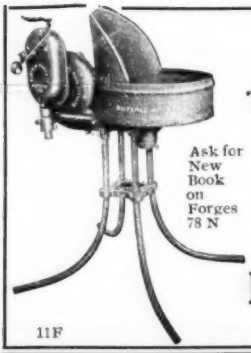

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Abrasive Materials.
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Accumulators, Hydraulic.
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Watson-Stillman Co., New York.
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Kolesch & Co., New York.
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Advertising.
Manufacturers Adv. Bureau, N. Y.
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Aerial Tramways.
Broderick & Bascom Rope Co., St. Louis.
Flory Mfg. Co., S., Bangor, Pa.
Lambert Hoist Engine Co., Newark.
Lidgerwood Mfg. Co., New York.

Air and Gas Compressors.
Blake Mfg. Co., Geo. F., New York.
Bury Compressor Co., Erie, Pa.
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Curtis & Co., Mfg. Co., St. Louis.
Deane Steam Pump Co., New York.
Hooker Steam Pump Co., St. Louis.
Ingersoll-Rand Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
McGowan Co., John H., Cincinnati.
Mietz, August, New York.
Norwalk Iron Wks., Norwalk, Ct.
Snow Steam Pump Wks., New York.
Worthington, Henry R., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg.

Air Drills.
Clayton Air Compressor Works, N. Y.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.

Air Hoists.
Brown Hoisting Mchy.Co.,Cleveland.
Blake Mfg. Co., Geo. F., New York.
Curtis & Co. Mfg. Co., St. Louis.
Ingersoll-Rand Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Northern Engineering Works, Detroit.

Air Motors.
Ingersoll-Rand Co., New York.

Air Receivers.
Graver Tank Works, Wm., East Chicago, Ind.
Koven & Bro., L. O., New York.
Scaife & Sons Co., Wm. B., Pittsburgh.

Air Separating Machinery.
Raymond Bros. Impact Pulverizer Co., Chicago.

Air Washers & Humidifiers.
Buffalo Forge Co., Buffalo.

Alarms, High and Low.
Davis Co., John, Chicago.
Wright Mfg. Co., Detroit.

Alcohol Engines.
Foos Gas Engine Co., Springfield, O.

Ammeters.
Bristol Co., Waterbury, Conn.
Western Electric Co., Chicago.
Weston Elec. Inst. Co., Waverly Pk., Newark, N. J.

Annunciators.
Ostrander & Co., W. R., New York.
Western Electric Co., Chicago.

Anti-Friction Bearings.
Chapman Ball Bearing Co., Boston.

Anti-Friction Metals.
Phosphor Bronze Smelting Co., Phila.
Poole Eng. & Mch. Co., Baltimore.

Architects.
Collins, D. C. Newman, New York.

Automatic Conveyors.
Lamson Consolidated S. S. Co., Boston.

Automatic Governors for Air Compressors.
Westinghouse Air Brake Co., Pittsburg.

Automatic Grab Buckets.
Broderick & Bascom Rope Co., St. Louis.
Hayward Co., New York.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.

Automatic Weighing Machines.
Automatic Weighing Machine Co., Newark.

Automobile Drop Forgings.
Chicago Drop Forge & Foundry Co., Kensington, Ill.

Automobile Parts.
Whitlock Coil Pipe Co., Hartford.

Ballast Unloaders.
Marion Steam Shovel Co., Marion, O.

Ball Bearings.
American Ball Co., Providence.
Chapman Ball Bearing Co., Boston.

Band Saws.
Fay & Egan Co., Cincinnati.

Bearing Metal.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Bearings, Roller.
Hyatt Roller Bearing Co., Newark.

Belt Conveyors.
Jeffrey Mfg. Co., Columbus.
Caldwell & Son Co., H. W., Chicago.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.

Belt Dressing (Waterproof).
Dixon Crucible Co., Jos., Jersey City.

Belt Shifters.
Mason Regulator Co., Boston.

Belting.
Boston Belting Co., Boston.
Eureka Fire Hose Mfg. Co., N. Y.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Chicago.

Belt Lacing.
Bristol Co., Waterbury, Conn.
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Bending Rolls.
Niles-Bement-Pond Co., New York.
Sellers Co., Inc., William, Phila.

Binding Devices.
Baker-Vawter Co., Chicago.

Bins & Racks, Steel.
Merritt & Co., Philadelphia.

Blast Furnaces.
Kennedy, Walter, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Blocks, Tackle.
National Equipment Co., Chicago.

Blowers.
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Buffalo Forge Co., Buffalo.
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Ohio Blower Co., Cleveland.
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Western Electric Co., Chicago.

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Blue Prints.
Keuffel & Esser Co., New York.
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Kolesch & Co., New York.

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Keuffel & Esser Co., Hoboken, N. J.
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Boiler Door Arches.
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Boiler Feeds.
Keyes & Son, F. E., New York.

Boiler Feeders.
Lunkenheimer Co., Cincinnati.
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Boiler Fronts and Fittings.
Amer. Steam Gauge & Valve Mfg. Co., Boston.
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C. W. Hunt Co., New York.
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Fay & Egan Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

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Phosphor Bronze Smelting Co., Phila.

Castings, Iron & Steel.
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Walworth Mfg. Co., Boston.

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Atlas Portland Cement Co., N. Y.
Edison Portland Cement Co., New York.
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Lawrence Cement Co., New York.
Lehigh Portland Cement Co., Allentown, Pa.
Pennsylvania Cement Co., New York.

Chains.
Diamond Chain & Mfg. Co., Indianapolis.
Morse Chain Co., Ithaca, N. Y.

Chain Belting.
Caldwell & Sons Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Morse Chain Co., Ithaca, N. Y.
Webster Mfg. Co., Chicago.

Chain Joint.
Morse Chain Co., Ithaca, N. Y.

Chain Pipe & Fittings Wrenches.
Williams & Co., J. H., Brooklyn.

Channeling Machines.
Ingersoll-Rand Co., New York.

Checks, Time, Pay & Trade.
Schwerdtle Stamp Co., Bridgeport.

Chemists.
Hunt & Co., Robt. W., Chicago.
Lunkenheimer Co., Cincinnati.

Chucks.
Almond Mfg. Co., Ashburnham, Mass.
American Tool & Mch. Co., Boston.
Niles-Bement-Pond Co., New York.

Clocks.
Standard Gauge Mfg. Co., Syracuse.

Clutches, Magnetic.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Mfg. Co., Cleveland.

Clutch Pulleys.
American Pulley Co., Philadelphia.
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Rockwood Mfg. Co., Indianapolis.

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Hunt Co., C. W., New York.
Interstate Engineering Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
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Webster Mfg. Co., Chicago.

Coal Cutters (Air and Electric).
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.

Coal and Ore Bunkers.
Morris Co., I. P., Philadelphia.

Coal Weighing Machine, Automatic.
Automatic Weighing Machine Co., Newark.

Coal-Mining Machinery.
Blake Mfg. Co., Geo. F., New York.
General Electric Co., New York.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Engine Co., Newark.
Link-Belt Eng'g Co., Phila.
McGowan Co., John H., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Robins Conveying Belt Co., Passaic, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Coal Screens.
Harrington & King Perforating Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Ludlow-Saylor Wire Co., St. Louis.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

Cocks.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

Coil Pipe.
National Pipe Bending Co., New Haven.
Whitlock Coil Pipe Co., Hartford.

Concrete Mixers.
Carlin's Sons Co., Thomas, Pittsburgh.
Dobbie Foundry & Machine Co., Niagara Falls.
Dunning, W. D., Syracuse, N. Y.
Eureka Machine Co., Lansing, Mich.
Jeffrey Mfg. Co., Columbus.
Wallace-Lindesmith Hoist Co., Ft. Wayne, Ind.

Concrete Reinforcing.
Lawrence Cement Co., New York.

Condensers.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
McGowan Co., John H., Cincinnati.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Struthers, Wells & Co., Warren, Pa.
Wheeler Condenser & Eng'g Co..N.Y.
Worthington, Henry R., New York.

Conduit Systems.
Gest. G. M., New York.

Continuous Elevators.
Caldwell & Son Co., H. W., Chicago.

Contractors, General.
Gilbreth, Frank B., New York.
Stone & Webster Engineering Corp., Boston.
White & Co., J. G., New York.

Contractors' Mchy.
Carlin's Sons Co., Thomas, Pittsburgh.
Wallace-Lindesmith Hoist Co., Ft. Wayne, Ind.

Controllers.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.

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Brown Hoisting Mchy. Co., Cleveland.
Browning Eng'g Co., Cleveland.
Caldwell & Sons Co., H. W., Chicago.
Dobbie Foundry & Machine Co., Niagara Falls.
Hayward Co., The, New York.
Hunt Co., C. W., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Phila.
Maris Bros., Philadelphia.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., Passaic, N. J.
Webster Mfg. Co., Chicago.

Conveying Systems.
Sturtevant Co., B. F., Hyde Park, Mass.

Conveyors, Automatic.
Lamson Consolidated S. S. Co., Boston.

Cooling Towers.
Hart, Jr., & Co., B. Franklin, New York.
Stocker, George J., St. Louis.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Worthington, Henry R., New York.

Coppersmiths.
Badger & Sons Co., E. B., Boston.
Griscom-Spencer Co., New York.

Copper Window Frames and Sashes.
Badger & Sons Co., E. B., Boston.

Cordage.
American Mfg. Co., New York.

Core Compound.
Obermayer Co., S., Cincinnati,

Corrugated Arches.
Canton Art Metal Co., Canton, Ohio.

Cost Systems.
Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.
New York & Buffalo Audit Co., Buffalo.
Webber, F. E., Cincinnati.
Williams & Staff, Stephen T., N. Y.

Cotton Oil Machinery.
Laidlaw-Dunn-Gordon Co., New York.

Couplings.
Almond Mfg. Co., Ashburnham, Mass.
Sellers & Co., Inc., Wm., Phila.

Cranes.
Brown Hoisting Mchy. Co., Cleveland.
Browning Eng'g Co., Cleveland.
Bucyrus Co., So. Milwaukee.
Curtis & Co. Mfg. Co., St. Louis.
Dobbie Foundry & Machine Co., Niagara Falls.
Hayward Co., The, New York.
Industrial Works, Bay City, Mich.
Interstate Engineering Co., Cleveland.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.
Sellers & Co., Inc., Wm., Phila.
Wood & Co., R. D., Phila.

Crane Motors.
Browning Eng'g Co., Cleveland.
Western Electric Co., Chicago.

Crucibles.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Crushers, Ore, Phosphate Rock
Jeffrey Mfg. Co., Columbus.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Raymond Bros. Impact Pulverizer Co., Chicago.
Smidth & Co., F. L., New York.

Cupolas.
Obermayer Co., S., Cincinnati.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.

Cutters, Milling.
Pratt & Whitney Co., Hartford.

Damper Regulator.
D'Este Co., Julian, Boston.
Mason Regulator Co., Boston.

Derricks and Fittings.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Carlin's Sons Co., Thomas, Pittsburgh.
Contractors' Plant Mfg. Co., Buffalo.
Dobbie Foundry & Machine Co., Niagara Falls.
Lidgerwood Mfg. Co., New York.
National Equipment Co., Chicago.
Northern Engineering Works, Detroit.

Die Castings.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Die Embossers.
Wiggins Co., John B., Chicago.

Digesters.
Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Doors, Rolling.
Wilson Co., Jas. G., New York.

Draft, Mechanical.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Green Fuel Economizer Co., Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Drafting Room Equipment.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.
Weber & Co., F., Philadelphia.

Drawing Paper.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.

Drilling Machines.
American Tool Wks. Co., Cincinnati.
Barnes Co., W. F. & J., Rockford, Ill.
Clark, Jr., & Co., Jas., Louisville.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Inc., William, Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills, Diamond Core.
Ingersoll-Rand Co., New York.

Drills—Rock and Coal.
Clayton Air Compress Wks., N. Y.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Smidth & Co., F. L., New York.

Drop-Forged Wrenches.
Williams & Co., J. H., Brooklyn.

Drop Forgings.
Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.

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O. K. Tool Holder Co., Shelton, Pa.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Williams & Co., J. H., Brooklyn.
Wyman & Gordon, Worcester, Mass.

Dryers.

Buffalo Fdy. & Mch. Co., Buffalo.
Ruggles-Coles Eng'g Co., New York.

Drying Apparatus.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.

Dumps, Automatic.

Jeffrey Mfg. Co., Columbus.

Dust Collecting Systems.

Ohio Blower Co., Cleveland.

Dynamometers.

Lawrence Machine Co., Lawrence, Mass.

Dynamos.

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Dynamos, Steam Turbine.

De Laval Steam Turbine Co., Trenton.

Ejectors.

Buffalo Foundry & Machine Co., Buffalo.
Watson & McDaniel Co., Philadelphia.

Elbows, Pipe.

Lunkenheimer Co., Cincinnati.
Whitlock Coil Pipe Co., Hartford.
Williams Valve Co., D. T., Cincinnati.

Electric Bells.

Ostrander & Co., W. R., New York.
Western Electric Co., Chicago.

Electric Heating Apparatus.

Simplex Elec. Heating Co., Cambridgeport, Mass.
Western Electric Co., Chicago.

Electric Hoists.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
C & C Electric Co., New York.
Hunt Co., C. W., New York.
Dobbie Foundry & Machine Co., Niagara Falls.
Lambert Hoist Eng. Co., Newark.
Grable-Dunn Co., Chicago.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.
Western Electric Co., Chicago.

Elec. Light & Power Plants.

Foos Gas Engine Co., Springfield, O.
Stone & Webster Engineering Corp., Boston.

Electric Railways.

Stone & Webster Engineering Corp., Boston.

Electrical Furnaces.

Engelhard, Charles, New York.

Elec. Measuring Instruments.

Bristol Co., Waterbury, Conn.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Elec. Welding Outfits.

C & C Electric Co., New York.

Elevating and Conveying Machinery.

Dobbie Foundry & Machine Co., Niagara Falls.
Interstate Engineering Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Maris Bros., Philadelphia.
National Equipment Co., Chicago.
Northern Engineering Works, Detroit.
Webster Mfg. Co., Chicago.

Elevator Insurance.

Fidelity & Casualty Co., New York.

Elevators.

Caldwell & Son Co., H. W., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Obermayer Co., S., Cincinnati.
Poole Eng'g Mch. Co., Baltimore.

Elevator Pressure Regulator.

Mason Regulator Co., Boston.

Emery Wheels.

Pittsburg Emery Wheel Co., Pittsburg.

Employers' Liability Insurance.

Fidelity & Casualty Co., New York.

Engineering Instruments.

Altenedер & Sons, Theo., Phila.
Bausch & Lomb Optical Co., Rochester.
Brandis Sons Co., Brooklyn.
Bristol Co., Waterbury, Conn.
Buff & Buff Mfg. Co., Boston.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Philadelphia.
Weber & Co., F., Philadelphia.
Young & Sons, Philadelphia.

Engineering Specialties.

D'Este Co., Julian, Boston.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.

Engineers.

Arnold Co., Chicago.
Barnaby, Charles W., New York.
Baum & Co., Frank G., San Francisco.
Brill, Geo. M., Chicago.
Collins, D. C. Newman, New York.
Cooper & Co., John A., Chicago.
Crane Estate, M. H., Chicago.
Doble, Robt. McF., Denver, Colo.
Gas Power Co., New York.
Hunt & Co., Robt. W., Chicago.
Keyes & Son, F. E., New York.
Kennedy, Julian, Pittsburg.
Kennedy, Walter, Pittsburg.
Loomis-Pettibone Co., New York.
McClure, Son & Co., G. W., Pittsburg.
Moses, P. R., New York.
Porter, H. F. J., New York.
Roberts, Nathaniel, Demarest, N. J.
Robinson, A. W., Montreal, Canada.
Roelker, H. B., New York.
Stone & Webster Engineering Corp., Boston.
Sutton, Frank, New York.
Thomson, T. Kennard, New York.
Von Schon, H., Detroit.
Webner, F. E., Cincinnati.
White & Co., J. G., New York.
Williams & Staff, Stephen T., N. Y.
Wood, George [illegible] Pittsburg.

Engines, Blow.

Southwark Fdy. & Mch. Co., Phila.

Engines, Gas & Gasoline.

(See Gas and Gasoline Engines.)

Engines, Marine.

Atlantic Works, East Boston, Mass.
Mietz, August, New York.

Engines, Steam.

American Blower Co., Detroit.
American Engine Co., Bound Brook, N. J.
Ball Engine Co., Erie, Pa.
Brown Hoisting Mchy. Co., Cleveland.
Buffalo Forge Co., Buffalo.
Griscom-Spencer Co., New York.
Harrisburg Fdy. & Mch. Wks., Harrisburg, Pa.
Ide & Sons, A. L., Springfield, Ill.
Mecklenburg Iron Works, Charlotte, N. C.
Ohio Blower Co., Cleveland.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Southwark Fdy. & Mch. Co., Phila.
Struthers, Wells & Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Troy Engine & Mch. Co., Troy, Pa.
Westinghouse, Church, Kerr & Co., New York.
Westinghouse Mch. Co., Pittsburg.

Engravers.

Wiggins Co., John B., Chicago.

Evaporators.

Blake Mfg. Co., Geo. F., New York.
Knowles Steam Pump Wks., N. Y.

Excavators.

Browning Engineering Co., Cleveland.
Bucyrus Co., So. Milwaukee, Wis.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
National Equipment Co., Chicago.
Robins Conveying Belt Co., Passaic, N. J.

Exhaust Heads.

Abendroth & Root Mfg. Co., Newburgh, N. Y.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, Ohio.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Whitlock Coil Pipe Co., Hartford.
Wright Mfg. Co., Detroit.

Exhaust Heads (Cast Iron).

Hoppes Mfg. Co., Springfield, O.
Ohio Blower Co., Cleveland.

Expanded Metal.

Roebling Construction Co., N. Y.

Fans, Electric.

Western Electric Co., Chicago.

Fans, Ventilating.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Green Fuel Economizer Co., Matteawan, N. Y.
Power Specialty Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

Feed Water Heaters and Purifiers.

Blake Mfg. Co., Geo. F., New York.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Griscom, Spencer & Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
McGowan Co., John H., Cincinnati.
National Pipe Bending Co., New Haven.
Petroleum Iron Wks. Co., Sharon, Pa.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.
Stewart Heater Co., Buffalo.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Whitlock Coil Pipe Co., Hartford.
Worthington, Henry R., New York.

Feed Water Regulators.

Chaplin-Fulton Mfg. Co., Pittsburg.
Safety Equipment Mfg. Co., Chicago.

Felt Roofing.

Barrett Mfg. Co., New York.

Field Glasses.

Bausch & Lomb Optical Co., Rochester.

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Files and Rasps.
Carver File Works, Philadelphia.
Barnett Co., G. & H., Phila.
Nicholson File Co., Providence.

Filing Cabinets.
Globe-Wernicke Co., Cincinnati.

Filter Presses.
Am. Tool & Machine Co., Boston.
Moore & Sons Corp., Samuel L., Elizabethport, N. J.
Niles-Bement-Pond Co., New York.

Filters.
Griscom-Spencer Co., New York.
Keyes & Son, F. E., New York.
Koven & Bro., L. O., New York.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.

Filters, Oil.
Wright Mfg. Co., Detroit.

Fire-Box Blocks.
McLeod & Henry Co., Troy, N. Y.

Fire Brick.
Maurer & Son, Henry, New York.
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Cincinnati.

Fire Clay.
McLeod & Henry Co., Troy, N. Y.
Carborundum Co., Niagara Falls, N.Y.

Fire Door Equipment.
Kinnear Mfg. Co., Columbus, O.
Wilson Co., Jas. G., New York.

Fire Escapes.
Merritt & Co., Philadelphia.

Fire Extinguishers.
Badger & Sons Co., E. B., Boston.

Fire Hose.
Eureka Fire Hose Mfg. Co., New York.

Fireproof Building Materials.
Maurer & Son, Henry, New York.
Roebling Construction Co., New York.

Fireproof Doors.
Rapp, John W., New York.

Fittings.
Crane Estate, M. H., Chicago.
Pittsburg Valve & Fittings Co., Barberton, Ohio.
Tight Joint Co., New York.

Flanges.
Lunkenheimer Co., Cincinnati.
Williams Valve Co., D. T., Cincinnati.

Flanges, Forged Steel.
Scully Steel & Iron Co., Chicago.

Flexible Shafts.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.
Almond Mfg. Co., Ashburnham, Mass.

Floor and Sidewalk Lights.
Brooks & Co., T. H., Cleveland.

Floor Plate, Wrought Steel.
Scully Steel & Iron Co., Chicago.

Fly Wheels.
Poole Eng'g & Mch. Co., Baltimore.

Forges.
Buffalo Forge Co., Buffalo.
Ingersoll-Rand Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Iron and Steel.
Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Griscom-Spencer Co., New York.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Wyman & Gordon, Worcester.

Foundry Equipment.
American Blower Co., Detroit.
Blake Mfg. Co., Geo. F., New York.
Buffalo Fdy. & Mach. Co., Buffalo.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.
Obermayer Co., S., Cincinnati.

Foundry Supplies.
Ingersoll-Rand Co., New York.
Obermayer & Co., S., Cincinnati.

Friction Clutches.
American Pulley Co., Philadelphia.
Am. Tool & Mch. Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.
Link-Belt Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.
Rockwood Mfg. Co., Indianapolis.

Friction Hoists.
Wallace-Lindesmith Hoist Co., Ft. Wayne, Ind.

Fuel Economizers.
Green Fuel Economizer Co., Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnace Builders.
Am. Gas Furnace Co., New York.
Continental Iron Wks., Brooklyn.
Gas Power Co., New York.
Kennedy, Julian, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Furniture, Metal.
Canton Art Metal Co., Canton, Ohio.

Fused Silica Ware.
Engelhard, Charles, New York.

Gages—Pressure, Steam, Water.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Standard Gauge Mfg. Co., Syracuse.
Walworth Mfg. Co., Boston.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

Galvanizing.
Koven & Bro., L. O., New York.

Galvanometers.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Gas Blowers and Exhausters.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.

Gas-Composimeters.
Uehling Instrument Co., Passaic, N. J.

Gas Compressors.
Bury Compressor Co., Erie, Pa.

Gas Engine Indicators.
Amer. Steam Gauge & Valve Mfg. Co., Boston.

Gas & Gasoline Engines.
De La Vergne [illegible] Co., N. Y.
Du Bois Iron Works, Du Bois, Pa.
Foos Gas Engine Co., Springfield, O.
Mietz, August, New York.
Snow Steam Pump Wks., New York.
Struthers, Wells & Co., Warren, Pa.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

Gas Machines & Generators.
Am. Gas Furnace Co., New York.
Gas Power Co., New York.
Morgan Const. Co., Worcester.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila.

Gas Producers.
Gas Power Co., New York.
Morgan Construction Co., Worcester.
Struthers, Wells & Co., Warren, Pa.
Westinghouse Machine Co., Pittsburg.

Gaskets.
Boston Belting Co., Boston.

Gear Cutting Machines.
Pratt & Whitney Co., Hartford.

Gearing.
Bilgram, Hugo, Phila.
Blake Mfg. Co., Geo. F., New York.
Caldwell & Son Co., H. W., Chicago.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
New Process Rawhide Co., Syracuse.
Nuttall Co., R. D., Pittsburg.
Phila. Gear Works, Inc., Philadelphia.
Poole Eng'g & Mch. Co., Baltimore.
Sellers Co., Inc., Wm., Phila.
Stow Flexible Shaft Co., Phila.

Generating Sets.
American Blower Co., Detroit.
Browning Engineering Co., Cleveland.
Buffalo Forge Co., Buffalo.
Crocker-Wheeler Co., Ampere, N. J.
Mietz, August, New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park Mass.
Western Electric Co., Chicago.

Gold Dredging Machinery.
Bucyrus Co., So. Milwaukee.

Gold Milling Machinery.
Mecklenburg Iron Works, Charlotte, N. C.

Graphite.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Graphite Bushings.
Graphite Lubricating Co., Bound Brook, N. J.

Grates, Traveling Link.
Green Engineering Co., Chicago.

Grease Extractors.
Griscom-Spencer Co., New York.

Grinding Machinery.
Western Electric Co., Chicago.

Grinding & Polishing Mchy
Clarke, Jr., & Co., Jas., Louisville.
Crocker-Wheeler Co., Ampere, N. J.
Helwig Mfg. Co., St. Paul.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison.
Pratt & Whitney Co., Hartford.
Pittsburg Emery Wheel Co., Pittsburg.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Grinding & Pulverizing Mchy.
Bradley Pulverizer Co., Boston.
Dunning, W. D., Syracuse.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Raymond Bros. Impact Pulverizer Co., Chicago.
Smidth & Co., F. L., New York.

Grinding Wheels.
Carborundum Co., Niagara Falls, N.Y.
Pittsburg Emery Wheel Co., Pittsburg.

Grinding Wheels (Alundum).
Norton Co., Worcester, Mass.

Gutters, Conductor Pipe, etc.
Canton Art Metal Co., Canton, Ohio.

Hack Saws.
Niles-Bement-Pond Co., New York.

Hammers, Electric.
Helwig Mfg. Co., St. Paul.
Northern Elec. Mfg. Co., Madison.

Heating and Ventilating Apparatus.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.

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Griscom, Spencer & Co., New York.
Lord & Burnham Co., Irvington-on-Hudson, N. Y.
Ohio Blower Co., Cleveland.
Simmons Co., John, New York.
Stewart Heater Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Western Electric Co., Chicago.

Heating Installations (Screens for).

Harrington & King Perforating Co., Chicago.

Hogs or Edging Grinders.

Mitts & Merrill, Saginaw, Mich.

Hoisting Engines and Mchy.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Carlin's Sons Co., Thomas, Pittsburgh.
Contractors' Plant Mfg. Co., Buffalo.
Dobbie Foundry & Machine Co., Niagara Falls.
Flory Mfg. Co., S., Bangor, Pa.
Foos Gas Engine Co., Springfield, O.
Grable-Dunn Co., Chicago.
Hayward Co., New York.
Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Interstate Engineering Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mietz, August, New York.
National Equipment Co., Chicago.
Northern Engineering Works, Detroit.
Robins Conveying Belt Co., Passaic, N. J.
Sellers Co., Wm., Inc., Phila.
Wallace-Lindesmith Hoist Co., Ft. Wayne, Ind.
Western Electric Co., Chicago.

Hoisting Rope.

American Mfg. Co., New York.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Hose.

Boston Belting Co., Boston.
Eureka Fire Hose Mfg. Co., N. Y.

Hydraulic Fittings.

Tight Joint Co., New York.

Hydraulic Gauges.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Bristol Co., Waterbury, Conn.

Hydraulic Machinery.

Goulds Mfg. Co., Seneca Falls, N. Y.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.
Wood & Co., R. D., Philadelphia.

Hydraulic Presses.

Watson-Stillman Co., New York.

Hydraulic Rams.

Pelton Water Wheel Co., San Francisco.
Power Epecialty Co., New York.

Hydraulic Turbines.

Morris Co., I. P., Philadelphia.

Ice-Mak'g & Refriger. Mchy.

De La Vergne Machine Co., N. Y.
Roelker, H. B., New York.

India Oil Stones.

Norton Co., Worcester, Mass.

Indicators.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Standard Gauge Mfg. Co., Syracuse.

Industrial Methods.

Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.
Webner, F. E., Cincinnati.
Williams & Staff, Stephen T., N. Y.

Industrial Railways.

C. W. Hunt Co., New York.
Koppel Co., Arthur, Pittsburg.

Ingots.

Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Injectors.

Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Sellers & Co., Inc., Wm., Phila.

Insurance.

Fidelity & Casualty Co., New York.

Internal Gearing.

Nuttall Co., R. D., Pittsburg.

Iron & Steel Merchants

Scully Steel & Iron Co., Chicago.

Iron and Steel Tubular Poles.

Electric Railway Equipment Co., Cincinnati.

Jacks, Hydraulic.

Watson-Stillman Co., New York.

Keyseaters.

Mitts & Merrill, Saginaw, Mich.

Keyseat Milling Machine.

Mitts & Merrill, Saginaw, Mich.

Laboratory Apparatus.

Bausch & Lomb Optical Co., Rochester.

Lamps, Electric.

General Electric Co., New York.
Sawyer-Man Elec. Co., Pittsburg.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Lathe Dogs.

O. K. Tool Holder Co., Shelton, Conn.

Lathes.

Am. Tool & Mch. Co., Boston.
Am. Tool Works Co., Cincinnati.
Barnes Co., W. F. & J., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Wm., Inc., Phila.

Lathe Tools.

O. K. Tool Holder Co., Shelton, Conn.

Leather Packing.

Detroit Leather Specialty Co., Detroit.

Lift Bridges.

Scherzer Rolling Lift Bridge Co., Chicago.

Lifting Magnets.

Browning Engineering Co., Cleveland.
Cutler-Hammer Clutch Co., Cleveland.
Elec. Controller & Mfg. Co., Cleveland.
National Equipment Co., Chicago.

Light Railways.

Hunt Co., C. W., New York.
Link-Belt Co., Phila.
Robins Conveying Belt Co., Passaic, N. J.

Lights, Floor & Sidewalk.

Brooks & Co., T. H., Cleveland.

Line Materials, Electric.

Electric Railway Equipment Co., Cincinnati.

Lockers, Steel.

Durand-Steel Locker Co., Chicago.
Merritt & Co., Philadelphia.

Locomotive Cranes.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Industrial Works, Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.
Northern Engineering Works, Detroit.

Locomotives.

Baldwin Locomotive Wks., Phila.
General Electric Co., New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Logging Machinery.

Lidgerwood Mfg. Co., New York.
National Equipment Co., Chicago.

Loose Leaf Accounting Forms.

Baker-Vawter Co., Chicago.

Lubricants.

Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Lubricating & Oiling Devices.

Griscom-Spencer Co., New York.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Williams Valve Co., D. T., Cincinnati.

Lubricators.

Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Williams Valve Co., D. T., Cincinnati.

Machine Knives.

Mitts & Merrill, Saginaw, Mich.

Machinery Exhibits.

Bourse, Philadelphia.

Machinery, Second Hand.

Niles-Bement-Pond Co., New York.

Machine Tools & Supplies.

Mitts & Merrill, Saginaw, Mich.

Machinists' Small Tools.

Pratt & Whitney Co., Hartford.

Malleable Castings.

Jeffrey Mfg. Co., Columbus, O.

Marine Boilers.

Griscom-Spencer Co., New York.
Lake Erie Boiler Works, Buffalo.
Morris Co., I. P., Philadelphia.

Measuring Tapes.

Keuffel & Esser Co., New York.
Kolesch & Co., New York.

Mechanical Messenger Service.

Lamson Consolidated S. S. Co., Boston.

Metal Lath.

Roebling Construction Co., N. Y.

Metal Shingles.

Canton Art Metal Co., Canton, Ohio.

Meters, Electric.

General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, Newark, N. J.

Milling Machines.

Adams Co., Dubuque, Iowa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.
Underwood & Co., H. B., Phila.

Mill Supplies.

Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Robins Conveying Belt Co., Passaic, N. J.
Williams Valve Co., D. T., Cincinnati.

Mine Cars.

Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

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Mining Hoists.
Wallace-Lindesmith Hoist Co., Ft. Wayne, Ind.

Mining Machinery.
Bradley Pulverizing Co., Boston.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Blake Mfg. Co., Geo. F., New York.
Crocker-Wheeler Co., Ampere, N. J.
Deane Steam Pump Co., New York.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
McGowan Co., John H., Cincinnati.
Mead-Morrison Mfrg. Co., Boston.
Mecklenburg Iron Works, Charlotte, N. C.
Norwalk Iron Wks., So. Norwalk, Ct.
Power Specialty Co., New York.
Raymond Bros. Impact Pulverizer Co., Chicago.
Robins Conveying Belt Co., Passaic, N. J.
Smidth & Co., F. L., New York.
Snow Steam Pump Wks., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Worthington, Henry R., New York.

Motors, Electric.
Browning Engineering Co., Cleveland.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Mfg. Co., Cleveland.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Stow Mfg. Co., Binghamton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Motor Parts.
Electric Railway Equipment Co., Cincinnati.

Motors, Steam Turbine.
De Laval Steam Turbine Co., Trenton.

Moulding Machines.
Blake Mfg. Co., Geo. F., New York.
Obermayer Co., S., Cincinnati.
Power Specialty Co., New York.

Name Plates.
Schwerdtle Stamp Co., Bridgeport.

Naphtha Gas Machines.
Am. Gas Furnace Co., New York.

Nozzle Piezometer Gauge.
Amer. Steam Gauge & Valve Mfg. Co., Boston.

Office Furniture.
Globe-Wernicke Co., Cincinnati.

Ohmmeters.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Oil Burners.
Petroleum Iron Wks. Co., Sharon, Pa.

Oiling Devices.
Nugent & Co., Wm. W., Chicago.

Oil and Grease Cups.
Williams Valve Co., D. T., Cincinnati.

Oil Engines.
De La Vergne Machine Co., N. Y.
Du Bois Iron Works, Du Bois, Pa.
Mietz, August, New York.
Moore & Sons Corp., Sam'l L., Elizabethport, N. J.

Oil Refining Plants.
Graver Tank Works, Wm., East Chicago, Ind.
Petroleum Iron Wks. Co., Sharon, Pa.

Oil Pumps.
Williams Valve Co., D. T., Cincinnati.

Oil Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Oil Tanks.
Graver Tank Works, Wm., East Chicago, Ind.
Wright Mfg. Co., Detroit.

Packing.
Boston Belting Co., Boston.
Chaplin-Fulton Mfg. Co., Pittsburg.
Detroit Leather Specialty Co., Detroit.
Jenkins Bros., New York.
Pennsylvania Rubber Co., Jeanette, Pa.

Paint Graphite.
Obermayer Co., S., Cincinnati.

Paints and Varnishes.
Dixon Crucible Co., Jos., Jersey City.

Paper-Mill Machinery.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Jeffrey Mfg. Co., Columbus.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Robins Conveying Belt Co., N. Y.
Snow Steam Pump Wks., New York.
Worthington, Henry R., New York.

Patent Attorneys.
Dieterich, C. A., New York.
Evans, Wilkins & Co., Washington, D. C.
Hill, Louis A., Washington, D. C.
Macdonald & Macdonald, New York.
Weeks, Edw. M., Washington, D. C.

Pattern-Makers' Machinery.
Fay & Egan Co., Cincinnati.
Pratt & Whitney Co., Hartford.

Pavement Filler.
Barrett Mfg. Co., New York.

Penstocks.
Atlantic Works, East Boston, Mass.
Graver Tank Works, Wm., East Chicago, Ind.
Lake Erie Boiler Works, Buffalo.
Petroleum Iron Wks. Co., Sharon, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Perforated Metal.
Caldwell & Son Co., H. W., Chicago.
Harrington & King Perforating Co., Chicago.

Photographic Lenses.
Bausch & Lomb Optical Co., Rochester.

Phosphor Bronze.
Lunkenheimer Co., Cincinnati.
Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pile Drivers.
Bucyrus Co., So. Milwaukee.
Ingersoll-Rand Co., New York.
Interstate Engineering Co., Cleveland.
National Equipment Co., Chicago.

Pinions.
New Process Raw Hide Co., Syracuse.

Pipe.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Crane Estate, M. H., Chicago.
Graver Tank Works, Wm., East Chicago, Ind.
Koven & Bro., L. O., New York.
Lynchburg Foundry Co., Lynchburg, Va.
Petroleum Iron Wks. Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburgh.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.
Wyckoff & Sons Co., A., Elmira, N. Y.

Pipe Bends.
Davis Co., John, Chicago.
National Pipe Bending Co., New Haven.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe-Cutting and Threading Machines.
Cox & Sons Co., Bridgeton, N. J.
Crane Co., Chicago.
Niles-Bement-Pond Co., New York.
Saunders' Sons, Inc., D., Yonkers.
Walworth Mfg. Co., Boston.

Pipe—Spiral Riveted.
Abendroth & Root Mfg. Co., Newburgh, N. Y.

Pipe Fittings, Cast Iron.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Davis Co., John, Chicago.
Pelton Water Wheel Co., San Francisco.
Pittsburg Valve & Fittings Co. Barberton, O.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.

Pipe, Wood.
Wyckoff & Sons Co., A., Elmira, N. Y.

Piping Contractors.
Crane Estate, M. H., Chicago.

Pitch.
Barrett Mfg. Co., New York.

Planers.
American Tool Wks. Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.

Planing Mill Machinery.
Fay & Egan Co., Cincinnati.

Plate Printers.
Wiggins Co., John B., Chicago.

Pneumatic Tools.
Clayton Air Compress. Wks., N. Y.
Curtis & Co. Mfg. Co., St. Louis.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.
Scully Steel & Iron Co., Chicago.

Pneumatic Tubes.
Lamson Consolidated S. S. Co., Boston.

Poles, Iron and Steel Tubular.
Electric Railway Equipment Co., Cincinnati.

Polishing Blocks & Wheels.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Pop Safety Valves.
American Steam Gauge & Valve Mfg Co., Boston.
Ashton Valve Co., Boston.
Davis Co., John, Chicago.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.

Portable Drilling Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Phila.

Portable Railways.
Koppel Co., Arthur, Pittsburg.

Portable Tools.
Underwood & Co., H. B., Phila.

Portland Cement.—See Cement.

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Powder Mixers.
Dunning, W. D., Syracuse.

Power-Transmission Mchy.
Almond Mfg. Co., Ashburnham, Mass.
American Pulley Co., Philadelphia.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Caldwell & Son Co., H. W., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Works, Charlotte, N. C.
Morse Chain Co., Ithaca, N. Y.
Niles-Bement-Pond Co., New York.
Northern Electric Mfg. Co., Madison.
Philips Pressed Steel Pulley Wks., Philadelphia.
Robins Conveying Belt Co., Passaic, N. J.
Rockwood Mfg. Co., Indianapolis.
Sellers & Co., Inc., William, Phila.
Webster Mfg. Co., Chicago.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wood & Co., R. D., Phila.

Preservative, Wood.
McKinney Co., C. S., New York.

Pressed Steel Pulleys.
American Pulley Co., Philadelphia.

Presses and Dies.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila.

Producers Gas Plants.
Foos Gas Engine Co., Springfield, O.

Production Engineers.
Williams & Staff, Stephen T., N. Y.

Prospecting Drills.
Ingersoll-Rand Co., New York.

Pulleys, Shafting & Hangers.
Am. Tool & Machine Co., Boston.
American Pulley Co., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Fay & Egan Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., Passaic, N. J.
Rockwood Mfg. Co., Indianapolis.
Sellers & Co., Inc., Wm., Phila.

Pulleys, Wrought Steel
American Pulley Co., Philadelphia.
Philips Pressed Steel Pulley Wks., Philadelphia.

Pulverizing Mills.
Dunning, W. D., Syracuse.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Raymond Bros. Impact Pulverizer Co., Chicago.
Smidth & Co., F. L., New York.

Pump Governors.
Albany Steam Trap Co., Albany.
Chaplin-Fulton Mfg. Co., Pittsburg.
Davis Co., John, Chicago.
Mason Regulator Co., Boston.

Pumps and Pumping Mchy.
Albany Steam Trap Co., Albany.
Blake Mfg. Co., Geo. F., New York.
Bucyrus Co., So. Milwaukee.
Buffalo Forge Co., Buffalo.
Cameron Steam Pump Wks., N. Y.
Carlin's Sons Co., Thomas, Pittsburgh.
Clayton Air Compress. Wks., N. Y.
Deane Steam Pump Co., New York.
De Laval Steam Turbine Co., Trenton.
Deming Co., Salem, Ohio.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holly Mfg. Co., New York.
Hooker Steam Pump Co., St. Louis.
Ingersoll-Rand Co., New York.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Knowles Steam Pump Wks., N. Y.
Pelton Water Wheel Co., Oakland, Cal.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Engine Co., Lawrence Mass.
McGowan Co., John H., Cincinnati.
Mecklenburg Iron Works, Charlotte, N. C.
Mietz, August, New York.
Morris Co., I. P., Philadelphia.
Morris Machine Wks., Baldwinsville, N. Y.
Stow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Watson-Stillman Co., New York.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Wood & Co., R. D., Phila.
Worthington, Henry R., New York.

Pumps, Syphon.
Chaplin-Fulton Mfg. Co., Pittsburg.

Pump Pressure Regulator.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Mason Regulator Co., Boston.

Pumping Engines.
Foos Gas Engine Co., Springfield, O.

Punching & Shearing Mchy.
Buffalo Forge Co., Buffalo.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.
Wood & Co., R. D., Phila.

Pyrometers.
Amer. Steam Gauge & Valve Mfg. Co., Boston.
Bristol Co., Waterbury, Conn.
Engelhard, Charles, New York.
Queen & Co., Philadelphia.
Uehling Instrument Co., Passaic,

Quarry Machinery.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
McGowan Co., John H., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.
Northern Engineering Works, Detroit.
Robins Conveying Belt Co., Passaic, N. J.

Quartz Glass.
Engelhard, Charles, New York.

Racks—Machine Cut.
Nuttall Co., R. D., Pittsburg.

Rail Braces.
Rail Joint Co., New York.

Rail Joints.
Rail Joint Co., New York.

Railway Shop Machinery.
Barnes Co., W. F. & J., Rockford, Ill.
Brown Hoisting Mchy. Co., Cleveland.
Clayton Air Compress. Wks., N. Y.
Fay & Egan Co., Cincinnati.
Laidlaw-Dunn-Gordon Co., New York.
Niles-Bement-Pond Co., New York.
Norwalk Iron Wks., So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.
Underwood & Co., H. B., Phila.

Rawhide Gears.
New Process Raw Hide Co., Syracuse.
Phila. Gear Works, Inc., Philadelphia.

Razor Hones.
Carborundum Co., Niagara Falls, N.Y.

Ready Roofing.
Barrett Mfg. Co., New York.

Reamers.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.

Reinforced Concrete Steel.
Roebling Construction Co., New York.

Relief Valves.
Davis Co., John, Chicago.

Resistance Banks and Units.
Elec. Controller & Mfg. Co., Cleveland.

Rheostats.
Simplex Elec. Heat. Co., Cambridge, Mass.

Rheostat Regulator.
Mason Regulator Co., Boston.

Riveting Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers Co., Wm., Inc., Phila.
Wood & Co., R. D., Phila.

Rivets—Boiler, Structural, etc.
Scully Steel & Iron Co., Chicago.

Rock Breakers.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., Passaic, N. J.

Roller Bearings.
Hyatt Roller Bearing Co., Newark.

Rolling Doors, Steel, Wood, Bronze.
Wilson Co., Jas. G., New York.

Rolling Lift Bridges.
Scherzer Rolling Lift Bridge Co., Chicago.

Rolling Mill Machinery.
Carlin's Sons Co., Thomas, Pittsburgh.
Crocker-Wheeler Co., Ampere, N. J.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., Passaic, N. J.

Roofing.
Barber Asphalt Paving Co., Philc.
Barrett Mfg. Co., New York.

Roofing Materials.
Barrett Mfg. Co., New York.

Roofing Metal.
Canton Art Metal Co., Canton, Ohio

Rope.
American Mfg. Co., New York.

Rope Transmission.
American Mfg. Co., New York.
Caldwell & Son Co., H. W., Chicago
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Phila.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Rubber Goods.
Boston Belting Co., Boston.
Jenkins Bros., New York.

Rubbing and Sharpening Stones,
Norton Co., Worcester.

Sand Mixers and Sifters.
Obermayer Co., S., Cincinnati.
Sellers & Co., Inc., William, Phila.

Sand Paper—
(See Carborundum Paper and Cloth.)

Sash Operating Device.
Canton Art Metal Co., Canton, Ohio.
Drouve Co., G., Bridgeport, Conn.
Irwin Mfg. Co., Thomas W., Pittsburgh.
Lord & Burnham Co., Irvington-on Hudson, N. Y.

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Saw-Mill Machinery.
Curtis & Co. Mfg. Co., St. Louis.
Fay & Egan, Cincinnati.
Jeffrey Mfg. Co., Columbus.
Mitts & Merrill, Saginaw, Mich.

Saws, Hack.
Niles-Bement-Pond Co., New York.

Scales.
Automatic Weighing Machine Co. Newark.

Screens, Mining.
Harrington & King Perforating Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Ludlow-Saylor Wire Co., St. Louis.

Screens, Rolled Slot.
Ludlow-Saylor Wire Co., St. Louis.

Screw Machines.
Jones & Lamson Mch. Co., Springfield, Vt.
National-Acme Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Screw Plates.
Card Mfg. Co., S. W., Mansfield, Mass.

Separators, Pneumatic.
Sturtevant Co., B. F., Hyde Park, Mass.

Separators, Steam and Oil.
American Tool & Mch. Co., Boston.
Austin Separator Co., Syracuse.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Direct Separator Co., Syracuse.
Goubert Mfg. Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield O.
Lindstrom, John T., Allentown, Pa.
Ohio Blower Co., Cleveland.
Watson & McDaniel Co., Phila.
Whitlock Coil Pipe Co., Hartford.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

Sewage Disposal Apparatus.
Merritt & Co., Philadelphia.

Sewage Ejectors.
Merritt & Co., Philadelphia.

Shaft Couplings, Flexible.
Elec. Controller & Mfg. Co., Cleveland.

Shapers.
Am. Tool Works Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.

Shaking Grates.
McEwen Bros., Wellsville, N. Y.

Sharpening Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Sheathing Papers.
Barrett Mfg. Co., New York.

Sheets—Black & Galvanized.
Scully Steel & Iron Co., Chicago.

Shelving, Steel.
Merritt & Co., Philadelphia.

Shutters (Fire).
Kinnear Mfg. Co., Columbus.

Skylights.
Canton Art Metal Co., Canton, Ohio.
Dronve Co., G., Bridgeport, Conn.
Irwin Mfg. Co., Thomas W., Pittsburgh.
Van Noorden Co., E., Boston.

Slate Machinery.
Flory Mfg. Co., S., Bangor, Pa.

Special Machinery.
Moore & Sons Corp., Samuel L., Elizabethport, N. J.
Morris Co., I. P., Philadelphia.

Speed Controllers.
Foster Engineering Co., Newark.

Spiral Gears.
Nuttall Co., R. D., Pittsburg.
Phila. Gear Works, Inc., Philadelphia.

Stacks.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Atlantic Works, East Boston, Mass.
Graver Tank Works, Wm., East Chicago, Ind.
Koven & Bro., L. O., New York.
Petroleum Iron Wks. Co., Sharon, Pa.
Smith & Son Co., Sam'l, Paterson,

Stamps—Steel, Alphabets and Figures.
Schwerdtle Stamp Co., Bridgeport.

Stamps, Time.
Automatic Time Stamp Co., Boston.

Stand Pipes.
Graver Tank Works, Wm., East Chicago, Ind.
Petroleum Iron Wks. Co., Sharon, Pa.
Smith & Son Co., Sam'l, Paterson,
Struthers, Wells & Co., Warren, Pa.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.

Steam Engine Indicators
American Steam Gauge & Valve Mfg. Co., Boston.

Steam Fitters.
Crane Estate, M. H., Chicago.

Steam Fitters' Supplies.
Simmons Co., John, New York.
Williams Valve Co., D. T., Cincinnati.

Steam Hammers.
Buffalo Foundry & Machine Co., Buffalo.
Sellers & Co., Inc., William, Phila.

Steam Pipe Covering.
Wyckoff & Sons Co., A., Elmira, N. Y.

Steam-Regulat'g Appliances.
Albany Steam Trap Co., Albany.
Crane Co., Chicago.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Foster Engineering Co., Newark.
Harrison Safety Boiler Wks., Phila.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati.
Mason Regulator Co., Boston.
Pittsburgh Valve & Fittings Co., Barberton, Ohio.
Powell Co., Wm., Cincinnati.
Power Specialty Co., New York.
Safety Equipment Mfg. Co., Chicago.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Valve Co., D. T., Cincinnati.

Steam Shovels.
Browning Engineering Co., Cleveland.
Bucyrus Co., Milwaukee.
Carlin's Sons Co., Thomas, Pittsburgh.
Davis Co., John, Chicago.
Hunt Co., C. W., New York.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.

Steam Specialties.
American Steam Gauge & Valve Mfg. Co., Boston.
Davis Co., John, Chicago.
Powell Co., Wm., Cincinnati.
Simmons Co., John, New York.
Wright Mfg. Co., Detroit.

Steam Traps.
Albany Steam Trap Co., Albany.
American Blower Co., Detroit.
Blake Mfg. Co., Geo. F., New York.
D'Este Co., Julian, Boston.
Chaplin-Fulton Mfg. Co., Pittsburg.
Lindstrom, John T., Allentown, Pa.
Ohio Blower Co., Cleveland.
Pittsburgh Valve & Fittings Co., Barberton, Ohio.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

Steam Fitters' Supplies.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.

Steam Hot Blast Apparatus.
American Blower Co., Detroit.
Sturtevant Co., B. F., Hyde Park, Mass.

Steel.
Jessop & Sons, Wm., New York.
Walworth Mfg. Co., Boston.
Wyman & Gordon, Worcester.

Steel Balls.
American Ball Co., Providence.
Chapman Ball Bearing Co., Boston.

Steel, High Speed.
Jessop & Sons, Wm., New York.
Wyman & Gordon, Worcester.

Steel Lockers.
Durand-Steel Locker Co., Chicago.
Merritt & Co., Philadelphia.

Stencils.
Schwerdtle Stamp Co., Bridgeport.

Stokers—Mechanical.
Babcock & Wilcox Co., New York.
Harrisburg Foundry & Mach. Wks., Harrisburg, Pa.
Under-Feed Stoker Co., Chicago.
Westinghouse Mch. Co., Pittsburg.

Strainers.
Lunkenheimer Co., Cincinnati.

Structural Iron Work.
Brown Hoisting Mchy. Co., Cleveland.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.

Structural Steel.
Scully Steel & Iron Co., Chicago.

Sugar-House Machinery.
Am. Tool & Mch. Co., Boston.
Blake Mfg. Co., Geo. F., New York.

Superheaters.
Babcock & Wilcox Co., New York.
Power Specialty Co., New York.

Switchboards.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Western Electric Co., Chicago.

Tanks.
Atlantic Works, East Boston, Mass.
Graver Tank Works, Wm., East Chicago, Ind.
Griscom-Spencer Co., New York.
Koven & Bro., L. O., New York.
Mecklenburg Iron Wks., Charlotte, N. C.
Petroleum Iron Wks. Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Smith & Son Co., Sam'l, Paterson,
Struthers, Wells & Co., Warren, Pa.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.

Taps and Dies.
Card Mfg. Co., S. W., Mansfield, Mass.
Crane Co., Chicago.
Pratt & Whitney Co., Hartford.

Tapes, Measuring.
Kolesch & Co., New York.

Temperature Regulators.
D'Este Co., Julian, Boston.

Tenoning Machines.
Fay & Egan Co., Cincinnati.

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Thermometers.
Bristol Co., Waterbury.
Hohmann & Maurer Mfg. Co., Rochester.
Queen & Co., Philadelphia.

Tiling, Rubber.
Pennsylvania Rubber Co., Jeannette, Pa.

Time Checks.
Schwerdtle Stamp Co., Bridgeport.

Tin Plates.
Canton Art Metal Co., Canton, Ohio.

Tool Holders.
O. K. Tool Holder Co., Shelton, Conn.

Tracing Cloth.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.

Trade Marks.
Macdonald & Macdonald, New York.

Traveling Link Grates.
Green Engineering Co., Chicago.

Trolleys.
Browning Engineering Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Maris Bros., Philadelphia.
Northern Engineering Works, Detroit.

Tumbling Barrels.
Northern Engineering Works, Detroit.

Tumbling Mills.
Obermayer Co., S., Cincinnati.

Tubes, Pneumatic.
Lamson Consolidated S. S. Co., Boston.

Tubular Poles—Iron & Steel.
Electric Railway Equipment Co., Cincinnati.

Turbines, Steam.
De Laval Steam Turbine Co., Trenton.
General Electric Co., Schenectady.
Morris Co., I. P., Philadelphia.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Mch. Co., Pittsburg.
Wheeler Condenser & Eng'g Co., Carteret, N. J.

Turbines, Water.
Pelton Water Wheel Co., San Francisco.

Turn Tables.
Mead-Morrison Mfg. Co., Boston.
Northern Engineering Works, Detroit.
Sellers & Co., Inc., Wm., Phila.
Tippett & Wood, Phillipsburg, Pa.

Turret Heads.
Almond Mfg. Co., Ashburnham, Mass.

Turret Lathes.
American Tool & Mch. Co., Boston.
American Tool Wks. Co., Cincinnati.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Twist Drills.
Pratt & Whitney Co., Hartford.

Underground Conduit Systems.
Gest, G. M., New York.

Unions.
Williams Valve Co., D. T., Cincinnati.

Vacuum and Draft Gauges.
Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester.
Standard Gauge Mfg. Co., Syracuse.

Vacuum Pumps.
Blake Mfg. Co., Geo. F., New York.
Buffalo Forge Co., Buffalo.
Bury Compressor Co., Erie, Pa.
Clayton Air-Compres. Wks., N. Y.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
McGowan Co., John H., Cincinnati.
Snow Steam Pump Wks., New York.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Worthington, Henry R., New York.

Valves, Balance.
Davis Co., John, Chicago.
Mason Regulator Co., Boston.

Valves, Blow-off.
Scully Steel & Iron Co., Chicago.

Valves—Gas, Steam and Water.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chaplin-Fulton Mfg. Co., Pittsburgh.
Crane Co., Chicago.
Crane Estate, M. H., Chicago.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Foster Eng'g Co., Newark.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati.
McGowan Co., John H., Cincinnati.
Mason Regulator Co., Boston.
Pittsburg Valve & Fittings Co., Barberton, Ohio.
Powell Co., Wm., Cincinnati.
Ross Valve Mfg. Co., Troy.
Simmons Co., John, New York.
Walch & Wyeth, Chicago.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Valve Co., D. T., Cincinnati.
Wood & Co., R. D., Philadelphia.

Valves, Reducing.
Chaplin-Fulton Mfg. Co., Pittsburg.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Mason Regulator Co., Boston.
Watson & McDaniel Co., Philadelphia.
Williams Valve Co., D. T., Cincinnati.

Ventilating Apparatus.
American Blower Co., Detroit.
Bristol Co., Waterbury, Conn.
Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Massachusetts Fan Co., Watertown, Mass.
Ohio Blower Co., Cleveland.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

Ventilating Apparatus (Screens for).
Harrington & King Perforating Co., Chicago.

Voltmeters.
Bristol Co., Waterbury, Conn.
Western Electric Co., Chicago.
Weston Elec. Instrument Co., Waverly Park, Newark.

Watchman's Time Clocks.
Ostrander & Co., W. R., New York.

Water Columns.
Wright Mfg. Co., Detroit.

Water Meters.
Worthington, Henry R., New York.

Water Purifying Apparatus.
Harrison Safety Boiler Wks., Phila.
Keyes & Son, F. E., New York.
Northern Water Softener Co., Madison, Wis.
Scaife & Sons Co., Wm. B., Pittsburg.

Water Softening Apparatus.
Harrison Safety Boiler Wks., Phila.
Keyes & Son, F. E., New York.
Northern Water Softener Co., Madison, Wis.
Scaife & Sons Co., Wm. B., Pittsburg.

Water Towers, Iron & Steel.
Tippett & Wood, Phillipsburg, N. J.

Waterproofing Compounds.
Horn Co., A. C., New York.

Water-Wheels.
Mecklenberg Iron Wks., Charlotte, N. C.
Pelton Water Wheel Co., San Francisco.
Poole Eng'g & Mch. Co., Baltimore.
Power Specialty Co., New York.
Wood & Co., R. D., Phila.

Water-Wheel Governors.
Woodward Governor Co., Rockford, Ill.

Water-Works Plants.
Foos Gas Engine Co., Springfield, O.

Water-Works Pumping Mchy.
Buffalo Forge Co., Buffalo.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holly Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Wood & Co., R. D., Phila.
Worthington, Henry R., New York.

Water-Works Supplies.
Power Specialty Co., New York.

Wells—Artesian.
Clayton Air Compress. Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.

Well Drilling Machines.
Williams Bros., Ithaca, N. Y.

Well Supplies.
Laidlaw-Dunn-Gordon Co., New York.
Williams Bros., Ithaca, N. Y.

Whistles.
Amer. Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.

Window Frames, Iron and Copper.
Badger & Sons Co., E. B., Boston.

Windows.
Van Noorden Co., E., Boston.

Wire-Drawing Machinery.
Morgan Construction Co., Worcester.

Wire Cloth and Screen.
Harrington & King Perforating Co., Chicago.
Ludlow-Saylor Wire Co., St. Louis.

Wire Lath.
Ludlow-Saylor Wire Co., St. Louis.
Roebling Construction Co., N. Y.

Wire Rope.
Broderick & Bascom Rope Co., St. Louis.
Jeffrey Mfg. Co., Columbus.
National Equipment Co., Chicago.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Wood Blocks.
U. S. Wood Preserving Co., New York.

Wood Pipe.
Wyckoff & Sons Co., A., Elmira, N. Y.

Wood Preservative.
McKinney Co., C. S., New York.

Wood-Working Machinery.
Fay & Egan Co., Cincinnati.
Ingersoll-Rand Co., New York.

Worm Gearing.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg.
Phila. Gear Works, Inc., Philadelphia.

Wrenches.
Williams & Co., J. H., Brooklyn.

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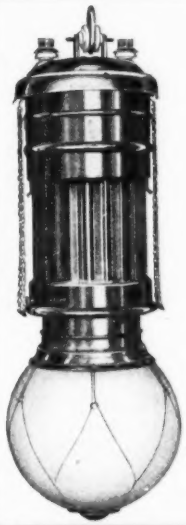
General Electric Company



G-I Flame Arc Lamps

Especially adapted for the lighting of construction yards, erecting shops, excavating work, and all free areas where a large volume of light is required.

Simple in Construction
Reliable in Operation

The penetrating qualities of the golden yellow light emitted by the G-I Flame Arc Lamp especially fits it for use in a foggy or smoky atmosphere.

Principal Office
Schenectady, N. Y.

Sales Offices in all Large Cities

1820

CRANES

MACHINE TOOLS

N.B.P.CO

STEAM HAMMERS

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AMERICAN

ALSEN'S CEMENT
45 BROADWAY NEW YORK
"Facts are better than assertions"

GERMAN

ROLLING DOORS
In Steel, Wood or Bronze for Closing Round Houses, Store Fronts, Freight Sheds, Car Barns, Elevator Openings, Etc., Etc.
Manufactured by **JAS. G. WILSON CO.,** 5 West 29th St., New York

KINNEAR STEEL AND WOOD ROLLING
DOORS, SHUTTERS AND PARTITIONS
THE KINNEAR MFG. CO., Send for Catalog "N" Columbus, Ohio, U.S.A.
BOSTON: 85 Water St. CHICAGO: 112 Clark St. PHILADELPHIA: 1011 Chestnut St.

IRON CLAD PORTLAND CEMENT
FINENESS—STRENGTH
SOUNDNESS—UNIFORMITY
The Glens Falls Portland Cement Co.
Glens Falls, N. Y. 156 Fifth Ave., New York

CENTURY

The Brand to Buy By

The packing that most successfully resists highest pressures and temperatures of superheated steam is

Century White Sheet Packing

To be sure you get the genuine look for the brand here shown, or the same with an outline in the form of a cross formerly used.

Century packing is a perfect combination of pure white rubber and asbestos fiber, and will never stick to the flange, rot or melt. It does not deteriorate in store, but holds its life and strength indefinitely.

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about this and kindred materials manufactured by

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Please mention The Engineering Magazine when you write.

THE CURRENT RECORD OF

IMPROVED MACHINERY

NEW METHODS NEW MATERIALS

NEW APPLIANCES

Glue Cookers.

THE accompanying cut shows a 10-gallon glue cooker shipped to the J. B. Lyon Company, Albany, N. Y., by the Westinghouse Electric & Mfg. Company. The Westinghouse Company builds a line of these cookers ranging from 5 to 25 gallons in capacity, and they are used by the manufacturers of printing press rollers, by bookbinders

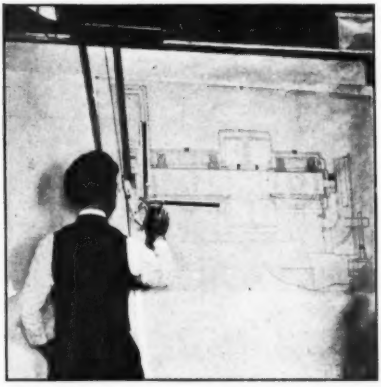
and large cabinet wood shops where it is necessary to melt and keep in working condition large quantities of glue or other compositions for replenishing the smaller glue pots used on the bench. These glue cookers are arranged with two heats, a high heat for melting down raw stock, and a low heat for holding the stock at a working consistency.

A New Drafting Instrument.

THE Emmert Mfg. Co., of Waynesboro, Pa., have undertaken the manufacture and sale of the Noyes vertical T-square, a drafting instrument of considerable novelty. This instrument comprises a vertically arranged T-square, guided at the top of the drawing board and having a protractor with scales sliding vertically thereon. The head of the T-square is provided with a set of four rollers guided upon a straight steel track which is fastened to the top of the drawing board. One pair of these rollers is bevelled, and runs on ball bearings so arranged that the weight of the head holds it upon the track with absolutely no lost motion, making possible a very free and sensitive movement. The head also carries a spring balanced drum to which is attached a cord which connects with the vertically sliding protractor and acts to hold the latter to the blade. The protractor is also guided upon the blade by rollers, giving it a very sensitive vertical movement. It is thus evident that the instrument always moves in horizontal and vertical parallel lines.

Pivoted to the sliding protractor is a forked arm to which interchangeable scales are attached. This arm is provided with a worm which engages notches cut in the rim of the protractor and which can be quickly pressed out of engagement therewith. These notches are spaced three degrees apart, thereby making possible an instantaneous setting of the instrument to any multiple of three degrees, which includes all the most commonly used angles: 0, 15, 30, 45, 60, 75 and 90. The 3-degree angle is exceedingly handy as it is the usual

draft given to patterns, is suitable for the conventional angle used for showing screw threads and various other cases. To obtain fine adjustment, the neck of the worm is graduated with 12 divisions so that one division represents ¼ of a degree. One half of this, or ⅛ degree, can be easily read, which is as fine as is ever necessary for drawing. Interchangeable scales are provided, furnished with any desired graduations.



In addition to the obvious advantages of the instrument for the horizontal board, it is practically indispensable for the vertical. It combines T-square, protractor, scales and triangle into one self-contained whole, depending from the top of the board. It eliminates the use of the parallel rule, with its inaccuracies and troubles, and its speed and accuracy in making projections alone will pay for its installation. A further extension of its use is in the making of large drawings. With this outfit it is possible to make full size drawings of quite a large machine with the same ease, accuracy and speed as on a 24 x 36 board.

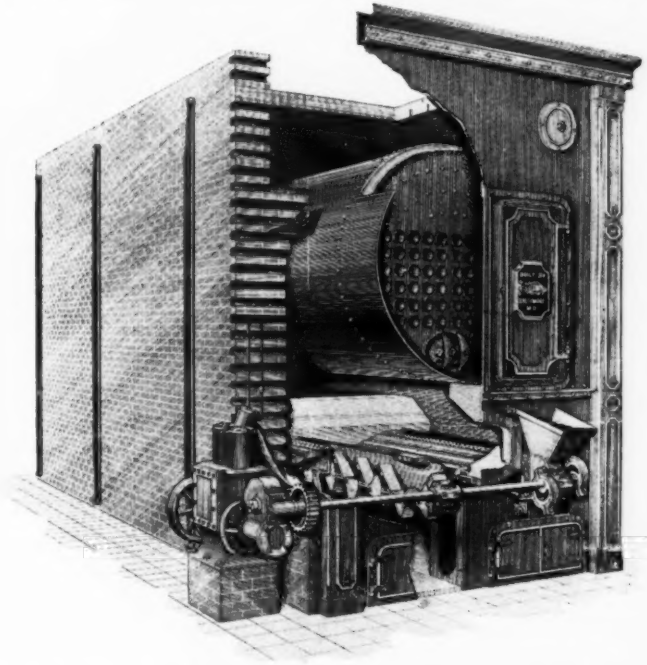
The advantages of this outfit will be readily apparent to every designer. Full size assembled drawings, with every part standing up in its natural and normal life size position, furnish almost the same advantage as a model. With such a layout the location of operating mechanism and handles can be tried, and their convenience and accessibility can be determined and a more accurate scale layout is always possible when full sized scale is used.

The Luckett Stoker

ENGINEERS and steam consumers should be interested in the demonstration of the capabilities of the Luckett Stoker, in operation in its daily routine at the boiler and machine works of E. J. Codd Company, Baltimore, Md. Since its operation one would judge by the appearance of its smokeless stack that the works were shut down. The plant is running and besides having a smokeless stack there is a saving in the consumption of coal.

This stoker as shown in the cut is very simple in construction and its operation can be readily understood by anyone. In the furnace there are two magazines so placed that each one will take care of half the width of the furnace. On the sides of these magazines are the grates which incline down toward the center and sides of the furnace. At the front end of each magazine is a hopper to which the coal is fed, either by the fireman or by chutes leading from the bottom of coal-bins overhead. After the coal is conveyed to the hoppers it is conveyed into the furnace by what are termed conveyors, the number depending on the depth of furnace. These conveyors oscillate about a shaft and work alternately, that is, while one is moving up the other is moving down. By this action the coal drops or fills in front of the conveyors, the first one pushes it back under the dead plates, and as it reaches its extreme forward position, the second conveyor has reached its extreme lower position and takes the coal that has been conveyed forward by the first conveyor and pushes it up the inclining bottom, known as uptakes, which is then partly thrown over the top of same to be conveyed by the third conveyor and partly pushed to the fire surface. This process is repeated by the succeeding conveyors. The conveyors are set so that each succeeding one will take a certain proportion of the coal conveyed to it, leaving the remainder to be pushed to the fire surface. This proportion is constant, no matter how fast or how slow the coal is fed. The portion of the coal in the course of being pushed to the fire surface is

gradually heated and ignited and thereby formed into coke. The process being continuous, heaps up the formed coke above the magazine which, partly through gravity and partly through the action of the conveyors, falls to the inclining grates on the sides and is gradually worked to the center and sides of the furnace. The continuous oscillating motion of the conveyors, gives a breathing motion to the fire bed, keeping it open and free for the circulation of air and doing away with the slice bar. In the center and sides of the furnace, the grates are made to shake at will of fireman. The conveyors of each magazine are operated by arms and rods connected to two eccentrics attached to shaft in front of boiler, known as stoker shaft. This shaft is driven by an engine placed at right angles to it, at the side of the boiler, connected through a reducing worm and spur gears.



It will be seen that the principle of feeding the coal continuously into the furnace below and the lifting effect of the conveyors, does away with the opening of the furnace doors for firing and slicing of fires. This saves the boiler and furnace from the objectionable inrush of cold air, and therefore eliminates smoke and destructive gases and maintains a uniform condition in the furnace and boiler. It is simple in construction; works automatically; saves fuel; is smokeless; no forced draught necessary; and there is no opening of furnace doors, which saves the boiler from sudden shocks of inrushing cold air, causing contraction and expansion, resulting in ruptures, etc. Should anything happen to the stoker, which is not very likely, the boiler can be fired by hand.

Hy-Rib Sheathing.

THIS is one of the "Kahn System" products placed on the market by the Trussed Concrete Steel Co. of Detroit. It consists of a series of high ribs 13/16 inch high 3½ inches apart rigidly

connected by rib lath. The ribs and the lath are manufactured complete from a single sheet of open hearth steel. The ribs give great strength and rigidity to the sheathing, make it self-centering for floors and roof, and entirely do away with studs in wall and partition construction. The Rib-Lath furnish a perfect surface for plastering; at the same time, it accurately locates the ribs and holds them rigidly in place. One of the uses of Hy-Rib sheathing is in connection with roof and light floor construction. When so used, the sheathing supplies, itself, the centering for the slab, reinforcement for the concrete, and a perfect surface for plastering underneath.

The construction is very simple. Lay Hy-Rib sheathing over the supports and pour in the concrete above. The concrete flows through the sheet only enough to supply a perfect key and there is no leakage. The plastering is applied directly to the under surface. For long span and heavy warehouse floors, Hy-Rib is also used without centering and is then curved into the form of an arch. For wall and partition work, Hy-Rib sheathing combines in a single sheet the ordinary lath and separate stud construction. It entirely does away with the use of studs. Simply set up the sheets, plaster both sides, and the wall is complete. It saves in the labor of wiring many sheets of lath to separate studs, besides being cheaper in first cost.

Hy-Rib sheathing is especially suitable for walls of foundries, car barns and industrial plants. It furnishes an indestructible fireproof construction in place of the short-lived corrugated sheathing and inflammable wooden construction. It is ideal for sidings of stucco houses and for constructing farm buildings, for partitions in office buildings, public buildings and hotels. For furring either the outside or inside of walls, the Hy-Rib is fastened against the wall with the lath side outward, thus furnishing a ¾ inch air space back of the lath, and no studs whatever are necessary. Similarly in suspended ceilings, Hy-Rib sheathing does away with the use of numbers of small channels and T's, commonly used as ribs, give the requisite stiffness.

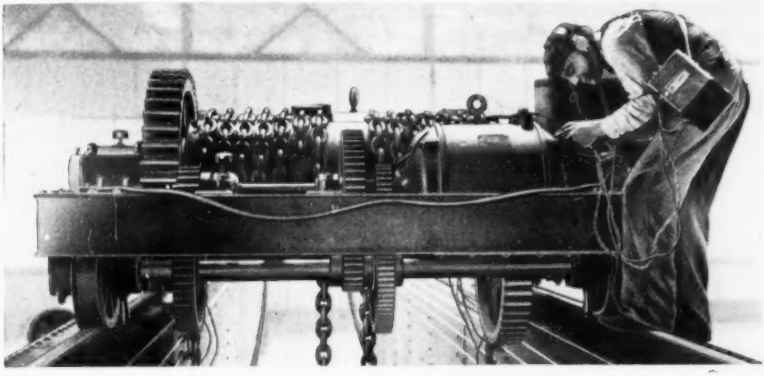
Hy-Rib sheathing is manufactured in four thicknesses of metal represented by U. S. standard gauges Nos. 30, 28, 26 and 24. It is furnished in sheets 10½ inches wide measured from center to center of outside ribs and is 6, 8 and 10 feet long. The sheathing is manufactured with a full size rib on either side, thus providing a perfect interlocking point when two sheets are spliced together.

The Electric Fault Finder.

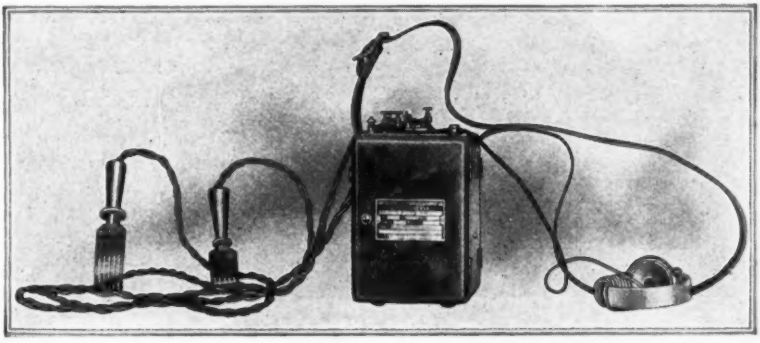
A NEW and useful instrument has just been brought out by The Electric Controller & Mfg. Co. of Cleveland, Ohio, for detecting and locating grounds, short circuits, open circuits, leaks and other faults in armature coils, field coils, control circuits, switchboard wiring or any other electrical circuit. Its name, the Electric Fault Finder, truly describes its use, since it not only indicates trouble, which is all that a magneto will do, but finds or locates the trouble. With the Electric Fault Finder, for instance, in a motor armature, a faulty coil can be absolutely located and the nature of the trouble definitely told. If a field coil is damaged, the layer in which the fault lies can be absolutely determined. If there is trouble in a bunch of control wires, in a multiple unit, train control, or other magnetic switch control, the faulty wire or pair of wires can be promptly located and the nature of the fault quickly found.

As will be seen from the accompanying views, the instrument consists of a small box provided with a strap so that it can be slung over the shoulder when

testing motors in place, such as under a car or on an electric overhead traveling crane. From this small box leads go to a telephone receiver fitted with a head piece so as to leave both hands free for testing. For working in very noisy



places, such as bridge and boiler shops, or some parts of steel mills, the head piece may be fitted with two receivers, one for each ear, which will shut out all sound save that received from the instrument. This arrangement not only



allows perfect testing to be done in noisy places, but enables partially deaf persons to use the instrument. In one case, by adjusting the rheostat to give a very loud sound (more than the normal ear could stand) and using two receivers, a very deaf man did very accurate work with this instrument. From the box, leads of convenient length go also to two test terminals.

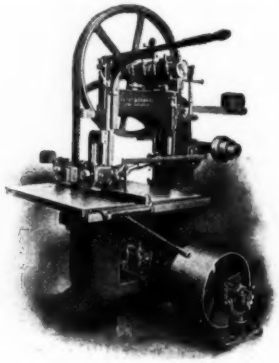
The Electric Fault Finder is small, portable and requires no outside current to operate. It requires only one man to operate under any conditions, so there is no excuse for the tester desiring a helper.

The Electric Controller & Mfg. Co. have prepared a neat little booklet describing the Electric Fault Finder and giving instructions in its use, which will be sent to interested persons upon request.

New Band Rip Saw.

THE machine illustrated herewith is claimed to embody every modern improvement in band saw construction and to stand the wear and tear of continuous service. It is especially built for car shop work and is used in the leading car shops of America. It rips 24 inches wide and takes 12 inches under the guide.

The feed rolls are powerfully driven and placed close together, enabling short stock to be fed successfully. The saw guides have sectional hardwood blocks arranged to permit of taking up the slightest wear. The machine is built along the same lines as the Fay & Egan No. 1 machine, but in addition to the features of the older tool it has other



improvements designed to give it a maximum of efficiency.

The straining of the blade is accomplished by a knife-edge balance and the claim is made that the lightest blades may be run at the highest speed without danger to saw or operator. The saving in time and kerf is said to be very large. The machine is known as No. 180. The maker is the J. A. Fay & Egan Co., 212-232 W. Front St., Cincinnati, Ohio.

Personal.

—John Wilkes, manager of the Mecklenburg Iron Works, Charlotte, N. C., died recently.

—Charles W. Barnaby, a mechanical engineer of wide practical experience in the East, middle West and abroad, has opened a consulting engineer's office at 309 Broadway, New York.

—J. B. Kane, who has had several years' experience in the factory of The American Steam Gauge & Valve Mfg. Co., Boston, has been promoted to the position of salesman and will make his headquarters at their New York branch.

Industrial Notes.

—Merritt & Co. announce the removal of their general offices from Philadelphia to Front and Arch streets, Camden, N. J.

—Hanna Engineering Works, 820 Elston avenue, Chicago, announce that they have recently added the entire riveting business of Quincy, Manchester, Sargent Co., Plainfield, N. J., to their line.

—The National Metal Moulding Co. has decided to enlarge its factory at Economy, Pa. Contract for the structural steel work has been awarded to Wm. B. Scaife & Sons Co., Pittsburg.

—William B. Scaife & Sons, Pittsburgh, have received contract for the new steel frame buildings required for the extension to the plant of the Driggs-Seabury Ordnance Corporation at Sharon, Pa.

—Gas Machinery Co., Citizens' Building Cleveland, announce that Wile producers formerly furnished by the Wile Power Co., will hereafter be exclusively manufactured and sold by them. J. I. Wile will be sales manager of the Wile Producer Department.

—Barrett Manufacturing Co., New York, have issued a well-printed pamphlet telling what their dust layer, known as "Tarvia," will and will not do. It also contains illustrations of quite a number of macadamized roads which have been made dustless by the application of Tarvia.

—The Cement Securities Co., Denver, have appointed F. L. Smidth & Co., 41 Cortlandt St., New York, their consulting engineers. The Securities Co. controls Portland cement plants operating at Portland, Colorado, and Devils Slide, Utah, and under construction at Three Forks, Montana, and El Paso, Texas.

—Another indication of the increasing business revival is to be found in the contract that has just been awarded by Harry E. Danner to Frank B. Gilbreth, general contractor, New York, for a cotton mill which is to be erected at Paterson, N. J., at a cost of $100,000. Construction is to begin immediately.

—H. W. Caldwell & Son Co., Chicago, have issued a booklet entitled "Something Better" in which they illustrate and describe machinery furnished Hecker-Jones-Jewell Mill, New York City. The pamphlet

is a little out of the ordinary in respect to reading matter and method of presenting the subject.

—The Mesta Machine Co., Pittsburg, has opened an office in Chicago at No. 844 Commercial National Bank Building, from which point the company's business in rolling mill machinery, gas and steam engines, condensers and machine molded gears, steel castings, etc., will be taken care of by Lane Johnson.

—The Pittsburgh Emery Wheel Co., Park Building, Pittsburgh, advise that they have been successful in bringing some vitrified emery wheels through on an order in perfect condition with 26-inch width of face. This is the second order of this kind that they have brought through successfully.

—In printing last month the very excellent paper on "The Correct Way to Apply Detachable Chain" due credit to the author of it was unfortunately omitted. This most excellent exposition of the reasons for running detachable chain in specified ways was prepared by Mr. S. B. Peck, vice-president of the Link-Belt Company, Chicago, Ill., who also furnished the lucid drawings which accompanied the explanations.

—The *Progress Reporter* for July, published by Niles-Bement-Pond Co., 111 Broadway, New York, contains numerous articles illustrating and describing a number of different machines manufactured by them; such as their combined slotting, boring, drilling and milling machine, 16-25-foot heavy pattern extension boring mill, 48-inch Niles steel-tired car-wheel lathe, 90-inch tire mill, 60-inch forge lathe, etc.

—Northwestern Expanded Metal Co., Old Colony Building, Chicago, have issued a booklet entitled "Expanded Metal Information," containing many valuable hints on specifications for reinforced concrete structures. They also have in course of preparation a series of pocket size booklets on kindred subjects and they will be glad to send them on application to all interested parties.

—The Trustees of the University of Illinois have recently let the contract for a new building for its College of Engineering, to be occupied wholly by the Department of Physics. The structure is to be built by B. Jobst & Sons, of Peoria, Ill., and is to cost, with its equipment, $250,000. It is to be erected just east of the present Engineering Building, and is to be known as the Physics Building.

—Turner Construction Co., 11 Broadway, New York, have been awarded the contracts for constructing the reinforced concrete floor in the car barn of the Third Avenue R. R. Co., at Sixty-fifth street and Third avenue, New York, and for the erection of approximately 1,000 feet of reinforced concrete fence on Sixth avenue, between Atlantic avenue and Pacific street, Brooklyn, for the Long Island R. R.

—The increasing trade of The S. Obermayer Co., in and around Erie, Pa., has made it necessary for them to open a branch warehouse in that city. W. L. Scott is in charge, and a full line of foundry facings, core compounds, plumbago and blackings will be carried for the present; and just as soon as conditions warrant their doing so a complete line of other foundry facings and foundry supplies manufactured by them will be carried in stock.

—A new seamless trolley pole is being put on the market by the R. D. Nuttall Co., Pittsburg. It is made of cold drawn seamless tubing of the highest grade to be obtained. Great strength is insured by a reinforcement at the bottom and a gradual taper at the top. The reinforcement is 16½ inches long and made of the same material as the pole proper. It is inserted cold and with such care as to fit that it practically becomes a part of the pole. The taper begins three feet from the top and reduces the diameter from 1½ inches at this point to one inch at the end. This gives to the pole greater strength and rigidity than is possible with any other design. The pole is made in all lengths up to 18 feet and combines rigidity with light weight. The average weight of the 12-foot poles is 22 pounds.

—The Youngstown Sheet & Tube Co., Youngstown, O., have contracted with Wm. B. Scaife & Sons Co., Pittsburgh, for an addition to their present 15,000-H.P. water softening and purifying system to provide for the 8,000-H.P. boilers which are being added for the operation of their new blast furnaces. The present water softening and purifying system is of the We-Fu-Go intermittent type, and consists of four

large treating and settling tanks and four mechanical gravity filters. When the additional apparatus is installed the system will consist of six large treating and settling tanks and seven mechanical gravity filters, and the total capacity will provide for 23,000-H.P. boilers, or 92,000 gallons of water per hour. Some recent contracts taken by this company are the following: Tennessee Coal, Iron & R. R. Co., 35,000 H.P.; Shenango Furnace Co., 8,000 H.P.; American Steel & Wire Co., 25,000 H.P.; Woodward Iron Co., 10,800 H.P.

—The August number of the *General Electric Review*, published by the General Electric Co., Schenectady, N. Y., contains the following articles: Alternating Current Underground Distribution, Part I, S. D. Sprong; Split Pole Converters, J. E. Woodbridge; Notes on the Desirability of Standard Specifications for Hard Drawn Copper Wire, W. H. Bassett and J. A. Capp; A Modern System of Street Lighting, C. A. B. Halvorson; The Relations Between Commercial and Electrical Engineers, Charles B. Burleigh; Motor Drive in a Soap Factory, C. W. Larson; Mine Haulage, C. W. Larson; Gem High Candle Power Units in the New White Factory, F. W. Willcox; Some Fuel Problems, H. M. Wilson; Heavy Traction Gearing, John Liston; Our Competitors in the Foreign Field, M. A. Oudin; New Alternating and Direct Current Ceiling Fan Motors, H. S. Baldwin; Color and Light, Louis Friedmann, and Notes.

—The DuBois Iron Works, DuBois, Pa., have been awarded the street lighting contract for the town of DuBois. The system will require 125 arc lights with provision for 25 additional arcs as required. The system will be operated entirely by gas engines of the twin tandem cylinder type, belted to General Electric Company's generators of the AC type. Other sales reported by them consist of two 80-H.P. tandem engines with direct connected generators to the Allegheny Trust Co., Allegheny; one 50-H.P. complete producer gas plant to the Philadelphia Gear Works, Inc., Philadelphia, for general service; one 175-H.P. tandem cylinder engine operating on natural gas to the Van Tassel Tannery, DuBois, Pa.; one 60-H.P. tandem cylinder engine direct connected to generator to the Hibner-Hoover Hardware Co., DuBois, Pa.; one 50-H.P. general service engine to the South Cleveland Lumber Co., Cleveland; one 50-H.P. engine to the Tarentum Glass Co., Tarentum, Pa.; one 50-H.P. engine to the Taylor Crush Stone Co., Falls Creek, Pa.; one 32-H.P. plant to the DuBois Laundry Co., DuBois, Pa.

—The Compania de Transvias Luz y Fuerza de Guadalajara, S. A., which company is the result of the combination of the two former electrical companies of that city, and operates not only the entire lighting system, but also the railway system of Guadalajara, have en route to Mexico a large order for additional electrical machinery which was bought from G. & O. Braniff & Company, of Mexico City. In order to meet the increasing demand for electrical power in Guadalajara, this company finding that their power generating stations at La Junta and Juanacatlan were insufficient, found it necessary to purchase a 750 K. V. A., modern, Westinghouse, three-phase, belted type generator, which will be installed at Juanacatlan. This new generator is but one of the four which will be installed as needed. The latter station was one of the first electric power plants in the country; the original installation consisting of single-phase machines, which were added to from time to time by other machines of the same type, as growth necessitated. A more modern method of transmitting electrical energy is by means of three-phase current, on account of the saving of amount of copper required in the transmission line and is now almost universally in use. By this change a greater amount of electrical energy is obtained from the same amount of water power by the adoption of this more modern type of machine, even by the use of the present water wheels, which will be retained in service. The Westinghouse Electric & Mfg. Co., Pittsburg, are supplying the new electrical machinery. This extension was necessitated not only by the operating of electrical railways in Guadalajara, which now have been in service for the last several months, but also by the additional power required from their present and new subscribers.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

Ball Bearings.

HESS-BRIGHT MFG. CO., 21st St. and Fairmount Ave., Philadelphia—Catalogue devoted to an illustrated description of ball bearings. 6 by 9 in.; pp. 34.

Blowers.

AMERICAN BLOWER CO., Detroit—Well-printed catalogue illustrating and describing blowers as installed in power houses, car barns, roundhouses, railroad shops, etc. 7 by 9 in.; pp. 50.

Coal Handling Machinery.

C. W. HUNT CO., West New Brighton, N. Y.—Pamphlet No. 081 illustrates and describes coal handling machinery, conveyors, industrial railways, etc. 3¼ by 6 in.; pp. 48.

Coal Handling Machinery.

JEFFREY MFG. CO., Columbus, O.—Bulletin No. 25 illustrates and describes a number of recent installations for handling coal and coke. 6 by 9 in.; pp. 12. Bulletin No. 16 is devoted to an illustrated description of electric rotary drills for drilling coal, slate, shale, rock salt, etc. 8 by 10 in.; pp. 10. Bulletin No. 15 treats of crab locomotives for gathering mine cars from the working face. 8 by 10 in.; pp. 16.

Concrete Piles.

HOLME CO., 34 W. 26th St., New York—Circular containing a brief illustrated description of corrugated concrete piles for foundations for buildings, bridges, chimneys, docks, bulkheads, etc. 6 by 9 in.; pp. 4.

Cranes.

NORTHERN ENGINEERING WORKS, Detroit—Booklet No. 24, pocket size, illustrating in condensed form, by means of about forty cuts, many of their designs of electric traveling cranes, hand power cranes, etc. Also electric hoists. 4½ by 3¼ in.; pp 32.

Cyanide Plants.

COLORADO IRON WORKS CO., Denver—Catalogue No. 10-B contains a brief illustrated description of the cyanide process and the machinery and equipment used. Fully indexed. 6 by 9 in.; pp. 112.

Drills.

CLEVELAND PNEUMATIC TOOL CO., Cleveland—Bulletin No. 10 illustrating and describing air hammer drills. 6 by 9 in.; pp. 12.

Dumping Grates.

WASHBURN & GRANGER, 120 Liberty St., New York—Booklet setting forth briefly, by illustration and description, the advantages claimed for the Dean dumping grate. 5¾ by 3½ in.; pp. 24.

Economizers.

B. F. STURTEVANT CO., Hyde Park, Mass.—"The Symbol of Durability" is the title of bulletin No. 102 illustrating and describing the metal-to-metal joints of the Sturtevant economizer. 3½ by 6 in.; pp. 8.

Electrical Equipment.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind.—Bulletins No. 1107 and 1108 illustrate and describe single-phase switchboard panels and multiphase revolving-field belted generators. 8 by 10½ in.; pp. 12.

Electrical Equipment.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletins Nos. 4596, 4597, 4600, 4601, 4602, 4603 and 4609 illustrate and describe respectively enclosing globes for arc lamps; astatic switchboard instruments; controllers for power and mining service; automatic voltage regulators for alternating and direct current generators; enclosed arc lamps for mills and factories; and lamp testing watt indicator. 8 by 10½ in.

Enameling Furnaces.

ROCKWELL FURNACE CO., 26 Cortlandt St., New York—Bulletin descriptive of an enameling furnace built without a muffle and using oil or gas as fuel. Illustrated. 9 by 12 in.; pp. 4.

Feed Water Purifiers.

F. E. KEYES & SON, 22 Broad St., New York—Circular illustrating and describing feed water purifiers. This device is installed between the heater and the boiler where it separates and removes the scale-forming material and sediment from the water. 3¾ by 8 in.; pp. 4.

Gas Engines.

OLNEY & WARRIN, 64 Centre St., New York—Booklet illustrating and describing gas and gasoline engines, together with tables of sizes of horizontal engines. 3¼ by 6½ in.; pp. 6.

ROOT & VANDERVOORST ENGINEERING CO., East Moline, Ill.—Catalogue No. 7 is devoted to an illustrated description of gas, gasoline, naphtha, distillate and alcohol engines, together with tables giving dimensions, weights, etc. 7 by 10 in.; pp. 56.

AUGUST MIETZ, 128-138 Mott St., New York—Catalogue A 46 illustrates and describes stationary and marine gas and oil engines operated by kerosene, alcohol, fuel oil, distillate and crude oil from 1 to 120 horsepower, together with tables giving dimensions. 9 by 6 in.; pp. 42.

DU BOIS IRON WORKS, Du Bois, Pa.—Catalogue containing an illustrated description of horizontal gas engines designed to operate on natural gas, illuminating gas and gasoline. This catalogue treats of sizes up to 50 horsepower. Larger sizes are described in another catalogue. 6 by 9 in.; pp 24. Bulletin G-No. 8 is devoted to gasoline engines of the stationary and portable types. Illustrated. 6 by 9 in.; pp. 8.

Gauges.

AMERICAN STEAM GAUGE & VALVE MFG. CO., 208-220 Camden St., Boston—Catalogue, including prices, illustrating and describing gauges, indicators and other appliances for governing,

indicating, measuring, recording, and controlling steam, water, air, gas, oil, ammonia, and all other pressures. 6 by 9 in.; pp. 128.

Graphite.

JOSEPH DIXON CRUCIBLE CO., Jersey City—Booklet, printed in two colors, treating of Ticonderoga flake graphite. Each page deals with some particular phase of the graphite subject, and at the bottom of the page is given a testimonial bearing whenever possible on the particular phase treated on that page. Much interesting and valuable information is given. 3½ by 6¼ in.; pp. 12.

Industrial Railways.

ERNST WIENER CO., 66 Broad St., New York—Folder illustrating and briefly describing flat platform cars, portable tracks, dump cars, etc. 4 by 9 in.; pp. 4.

Meters.

CENTRAL STATION STEAM CO., Detroit—Catalogue No. 2 treats of the theory and practice of condensation meters and meters for measuring boiler feed water. Illustrated. 6 by 9 in.; pp. 12. Catalogue No. 3 is devoted to an illustrated description of general equipment for district steam heating. 6 by 9 in.; pp. 28.

Pipe.

AMERICAN SPIRAL PIPE WORKS, West 14th St. and 48th Ave., Chicago—Catalogue describing the many different uses for which spiral riveted pipe is especially adapted. Also contains testimonial letters. Illustrated. 7¾ by 10 in.; pp. 16.

Power Presses.

ZEH & HAHNEMANN CO., Newark, N. J.—Catalogue illustrating and describing punching, arch, wedge adjustment, straight side, double crank, armature disk notching, double action, screw and drop presses. 4 by 9 in.; pp. 12.

Reinforced Concrete.

EXPANDED METAL AND CORRUGATED BAR CO., Frisco Bldg., St. Louis—The July number of "Designing Methods" is devoted to an illustrated description of bridges and culverts for highway traffic. 5½ by 8½ in.; pp. 106.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

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GRADUATE ELECTRICAL ENGINEER, with 8 years' factory experience, wishes position, assistant superintendent or foreman. Can manage any nationality. Address BOX 128, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-9

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FOR SALE—24' x 42"—15" bore Belt Fly Wheel, eight arm, sectional, Allis-Chalmers make. Perfect condition. LOUISVILLE COTTON MILLS CO., Louisville, Ky. 6-2

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THE ENGINEERING INDEX ANNUAL for 1907 embraces all branches of engineering, and clearly indexes alphabetically by subject about 9,000 important articles of permanent value which appeared during 1907 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 450 pages, 9¼ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT, by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

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FOR ALL PURPOSES

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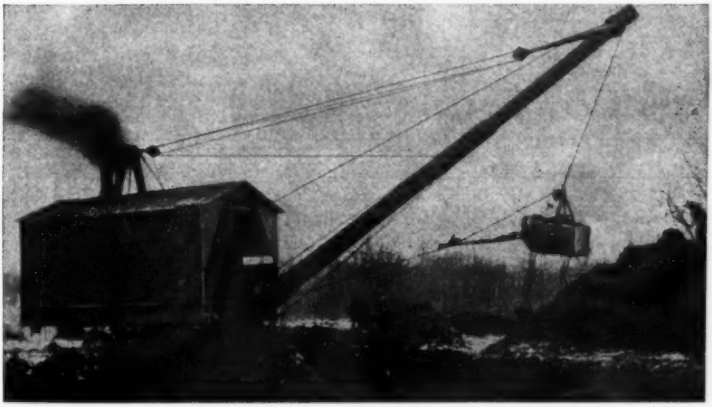
Portable Galvanometer for Bridge Work

LIDGERWOOD PATENT SCRAPER BUCKET EXCAVATOR



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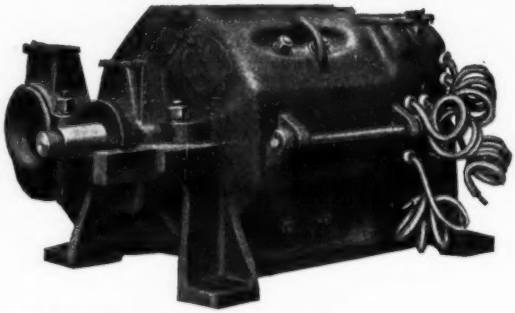

See Mill Motor Circular 1144

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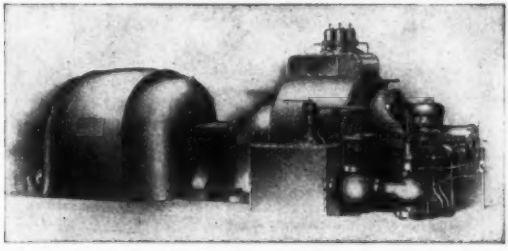

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of our single-flow turbines are retained in our double-flow type, and they have in addition, valuable features especially adapting them to the extra-heavy service for which they are intended.

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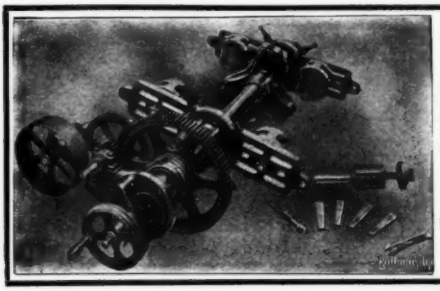

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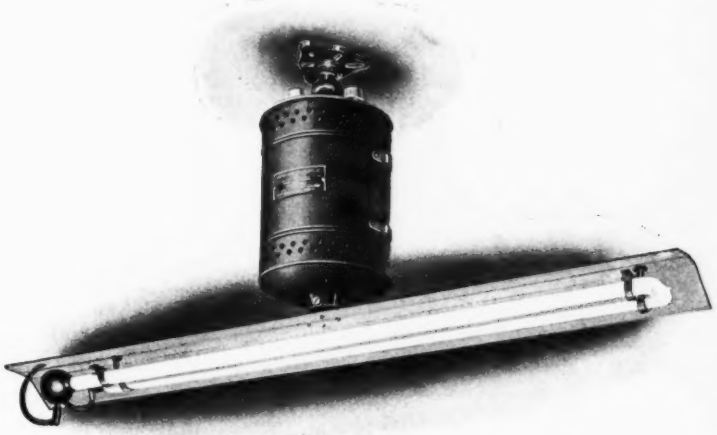

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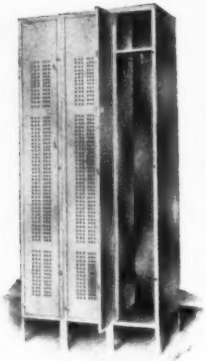

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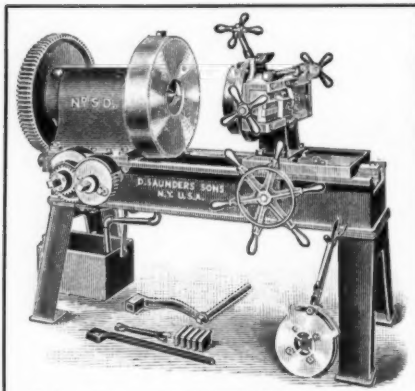

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Complete in all details, and are adapted to a very large range of work. Cut illustrates our No. 5 D Machine. Capacity, 1 to 6 inches.
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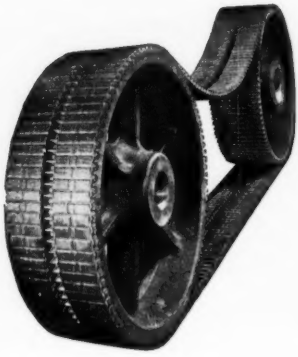

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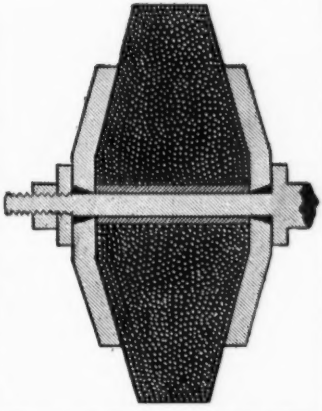

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of experimenting with gears when you can get the "Nuttall" cut or planed kind, without experimenting? We have a special rush department

If in a hurry, wire us

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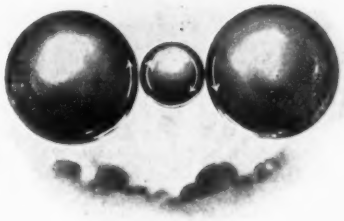

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Wherever it is desired to reduce friction the Chapman Ball Bearing may be profitably installed.

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Now Is the Time to Equip with New Process Noiseless Pinions

THERE are doubtless some places about every plant where the racket made by metal gears is a nuisance and the quiet running of New Process Noiseless Pinions would be a vast improvement. The pressure of business, however, for the past two years has kept most factory managers so busy that they have had no time to consider such refinements of their equipment. The present slackening in the rush should be taken advantage of to look into this matter and to prepare to have the benefit of Noiseless Gearing during the busy times which are soon to come. We will be glad to send our descriptive catalog for the asking.

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Thrust and Radial Ball Bearings for all purposes

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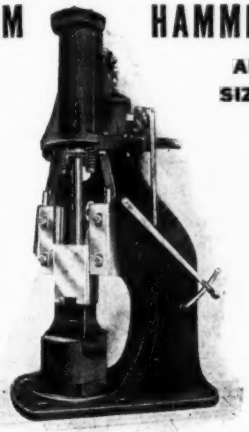

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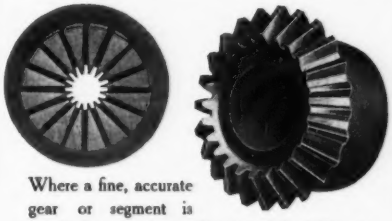

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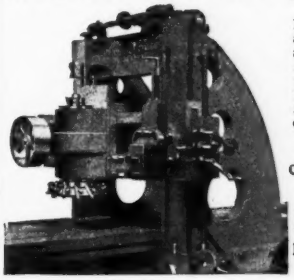

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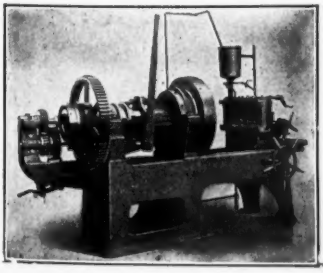

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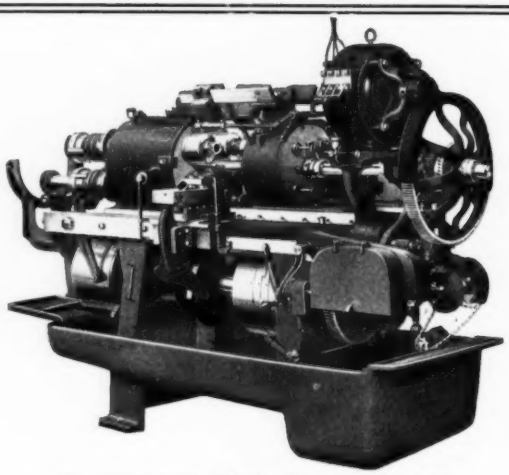

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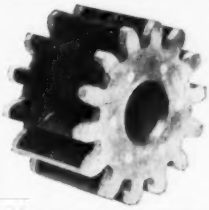

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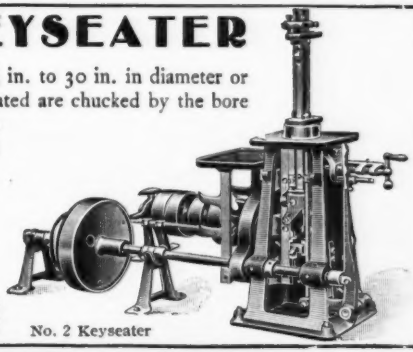

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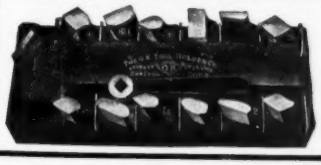

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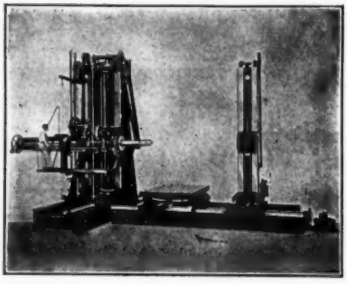

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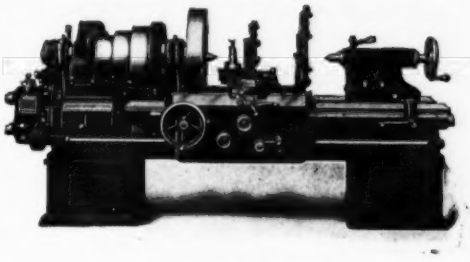

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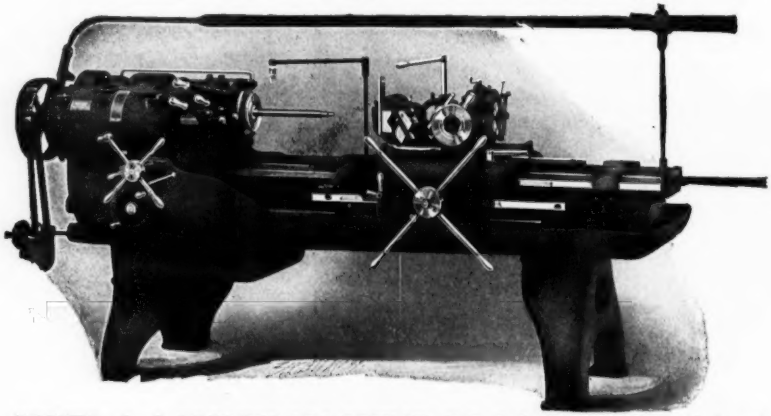

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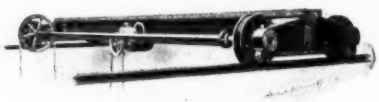

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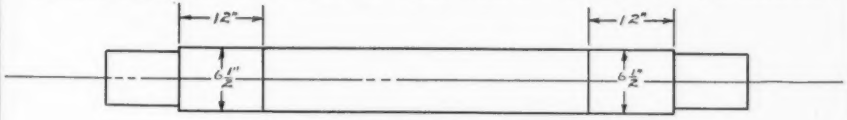

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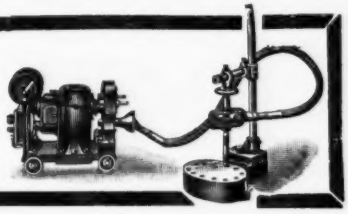

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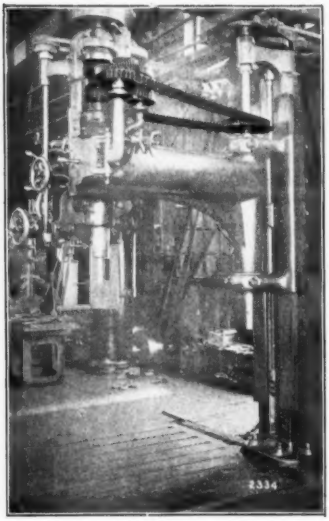

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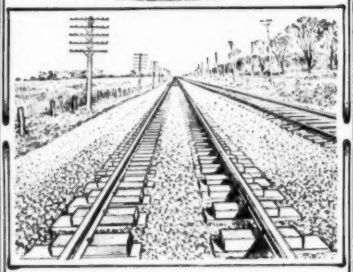

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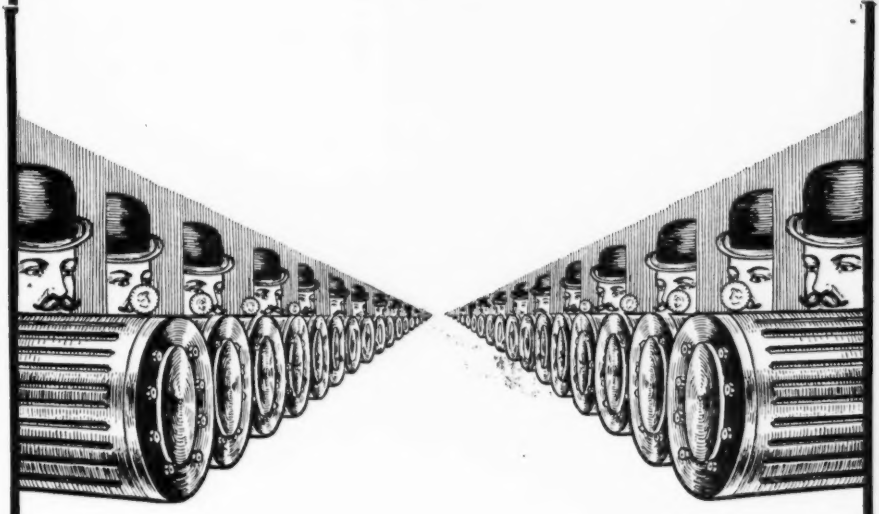

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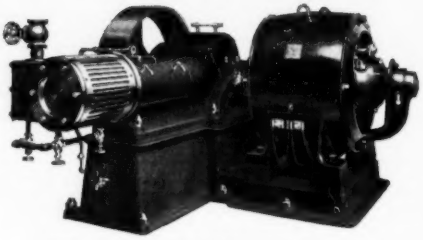

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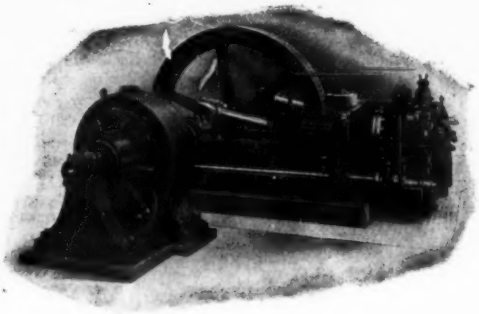

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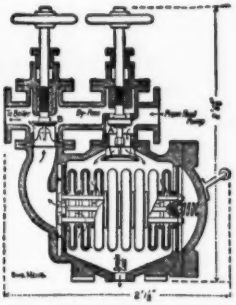

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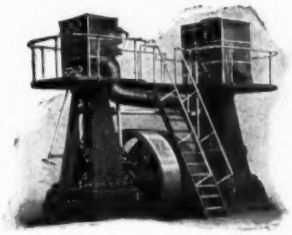

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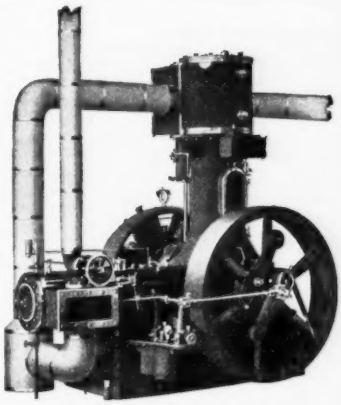

THE ENGINE FOR DRIVING ALTERNATORS

WHERE two alternating current electrical generators are run in parallel, their efficiency and regulation depends upon other things than the generators themselves. If the two generators are driven by engines of different types, or even by two ordinary engines of the same size and type, but with the pistons not moving in unison, cross-currents are set up, which waste power, reduce the capacity of the generator and interfere with the voltage regulation.

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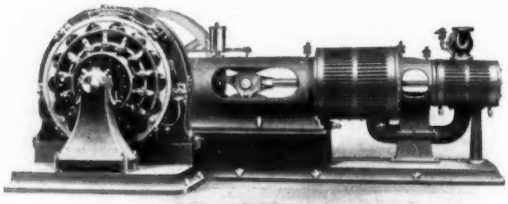

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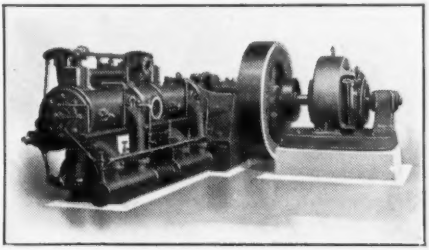

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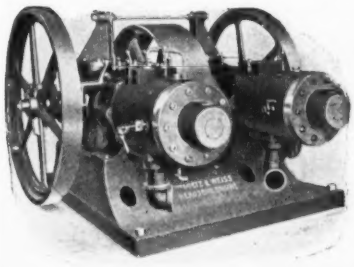

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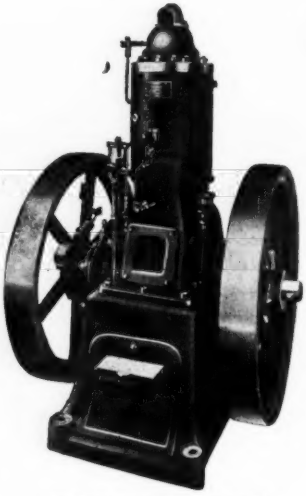

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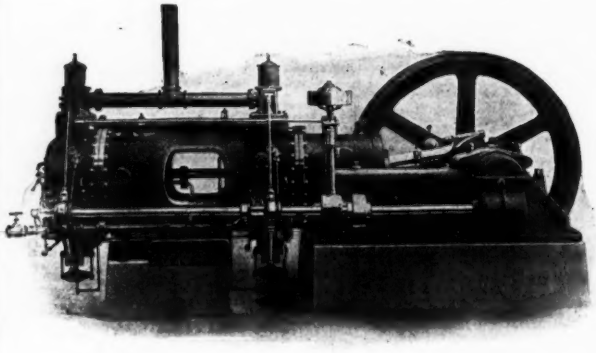

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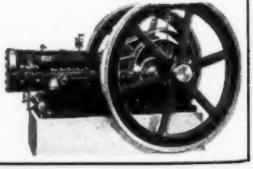

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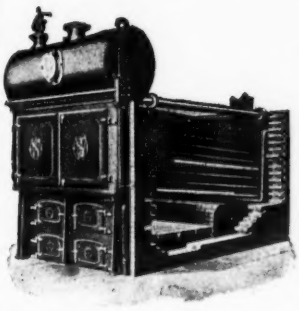

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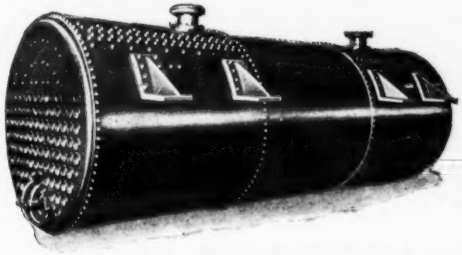

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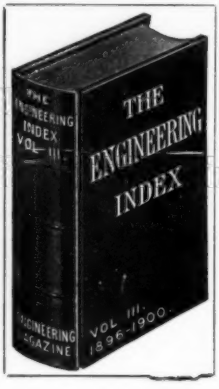

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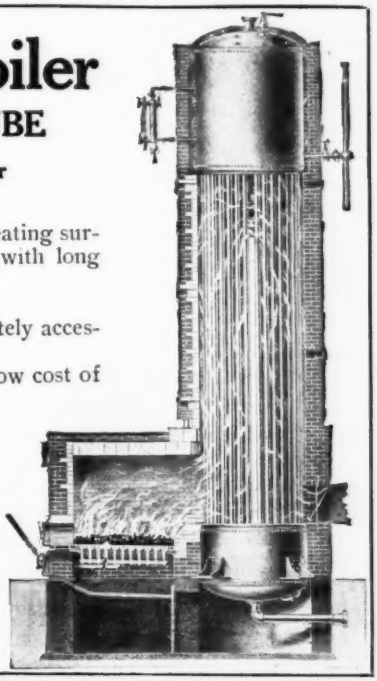

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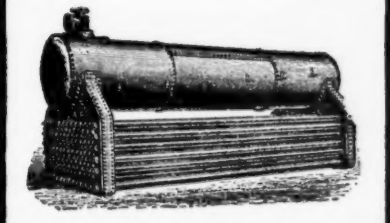

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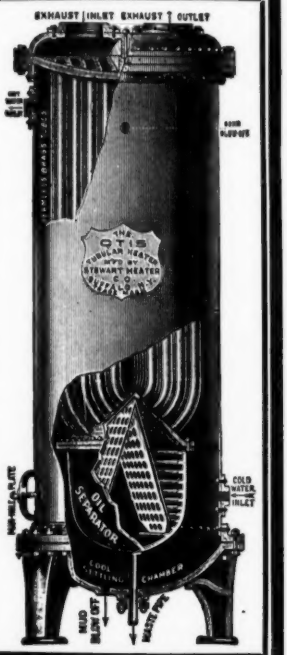

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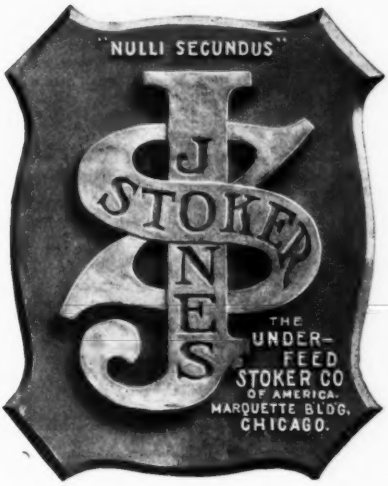

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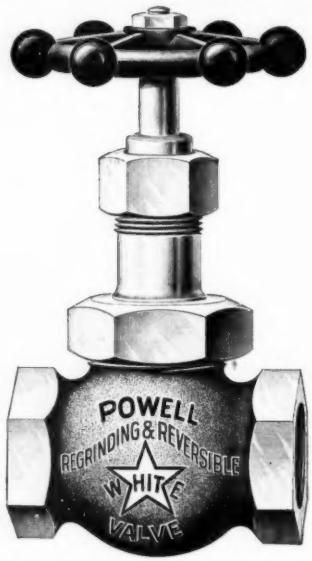

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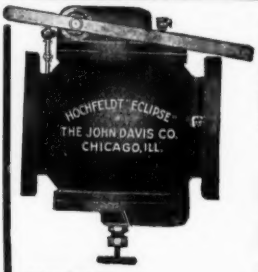

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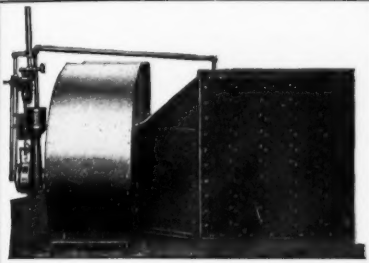

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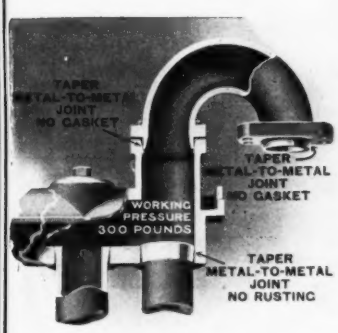

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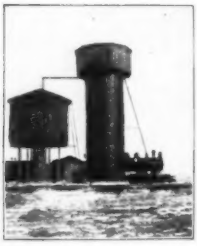

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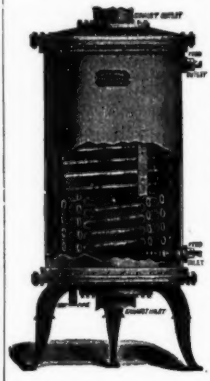

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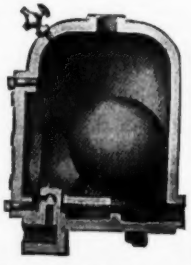

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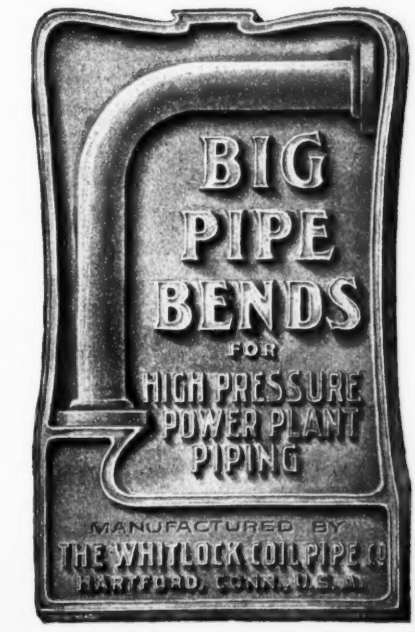

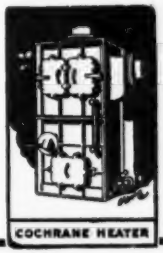

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Would like to have the equivalent of a spare or reserve boiler,
Would like to reduce your water bills,
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Would like to use condensation from surface condensers as boiler feed,
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Use large quantities of hot water,
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Would be interested in a coal saving of 16%,
Would like your feed water to enter the boilers always at 210° F.,
Would like to combine your Feed-Water Heater, independent oil separator, return and muffle tank all in one simple apparatus, thus saving a lot of valves and connections,—

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You may have read some of the Cochrane advertisements and may know in a general way what is claimed for the Cochrane Heaters and Separators, but have you ever figured out, or had figured out, just what they would accomplish in saving coal in your own plant?

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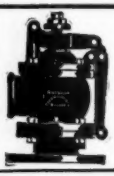

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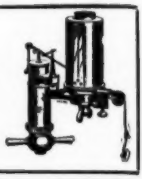

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DISCHARGES CONTINUOUSLY AND NEVER BLOWS STEAM.
MADE EXTRA HEAVY FOR HIGH PRESSURE.

We also manufacture Reducing Valves, Exhaust Pipe Heads, Separators for Live and Exhaust Steam, Blow Off Valves, Relief Valves, Ejectors, Etc. *Send for Catalogue.*

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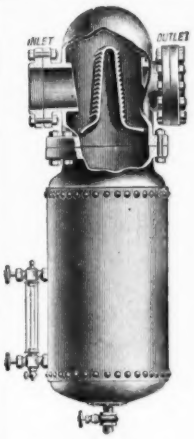

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FOR LIVE STEAM

Makes Wet Steam DRY

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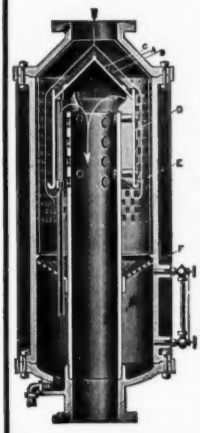

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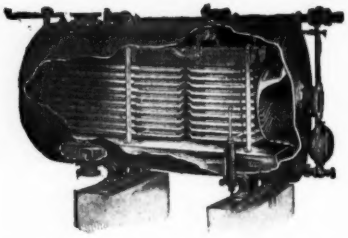
FEED-WATER HEATERS



have a large heating and lime-catching surface and bring the steam and water together on correct principles, giving the highest possible efficiency. Oil from the exhaust is thoroughly eliminated and all solids removed from the feed-water that crystallize at 212 degrees. For complete purification use a

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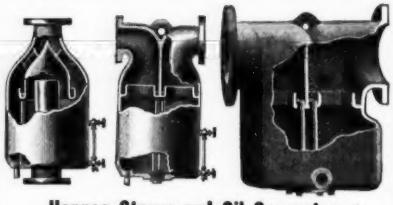

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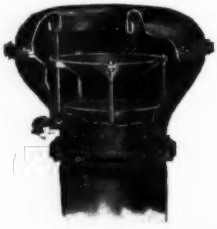

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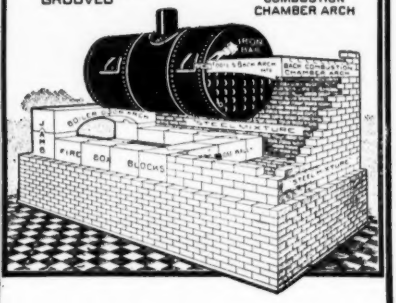

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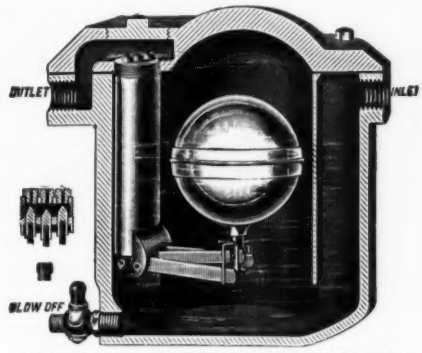

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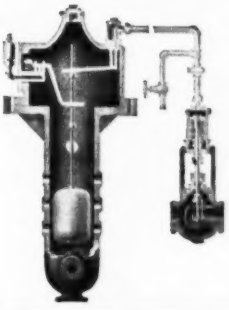

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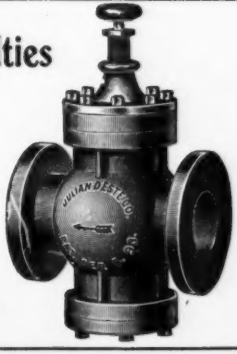

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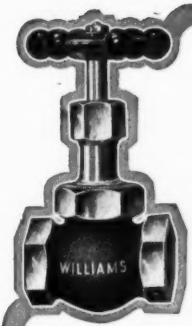

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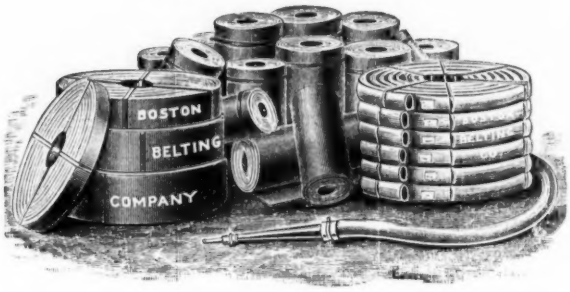

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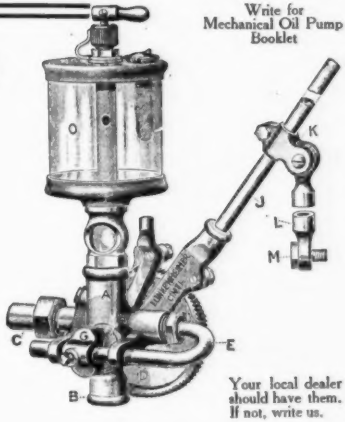

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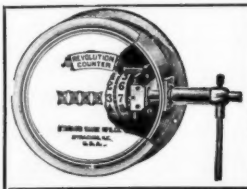

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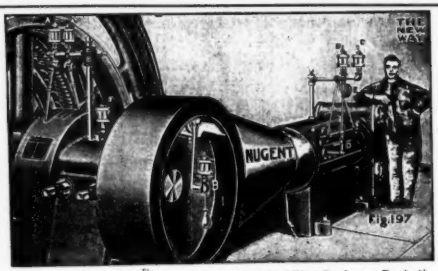

Key to Illustration: AA—Telescopic Eccentric Oiling Devices. B—Anti-Stand, Dust-Proof, Crank Pin Center Oiler. C—The Top Guide Oiler. DD—Telescopic Crosshead Pin Oiler. E—Indicator Reducing Motion, attached to Crosshead Pin Oiling Device.

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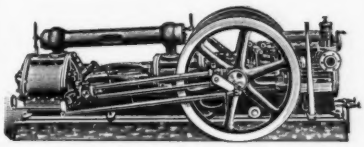

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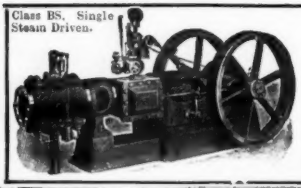
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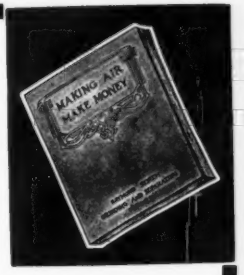

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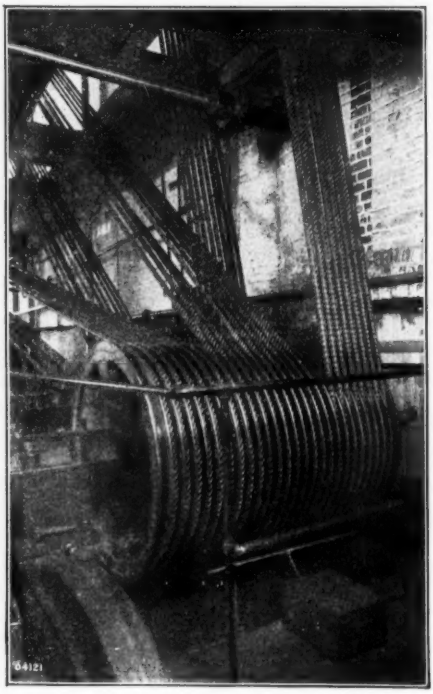

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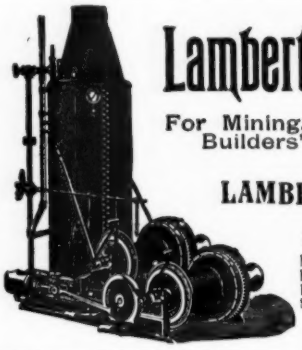

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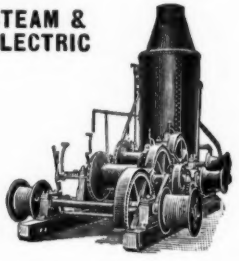

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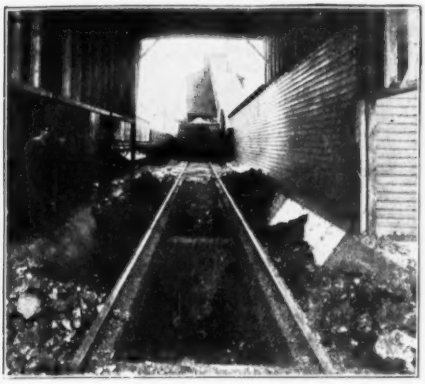

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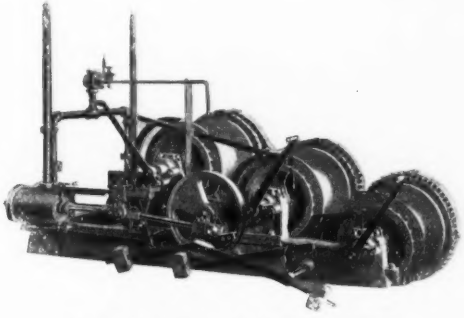

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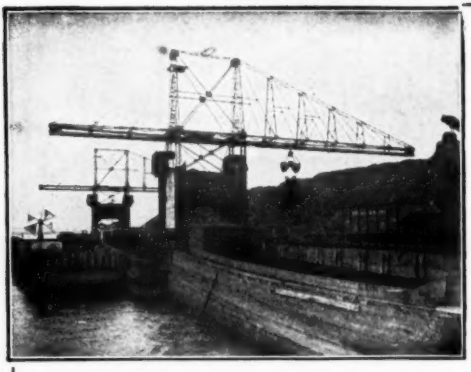

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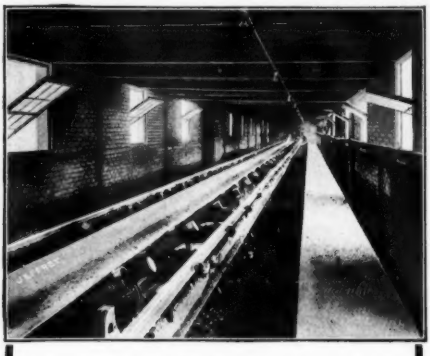

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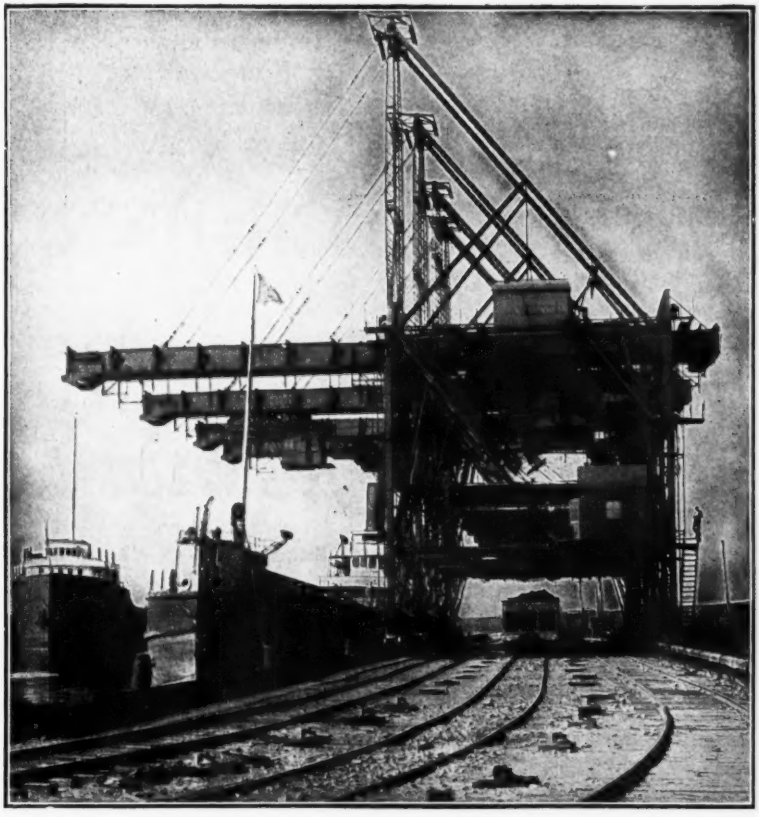

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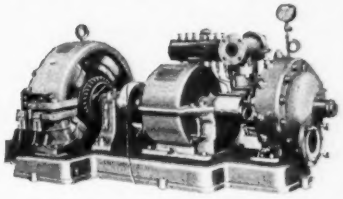

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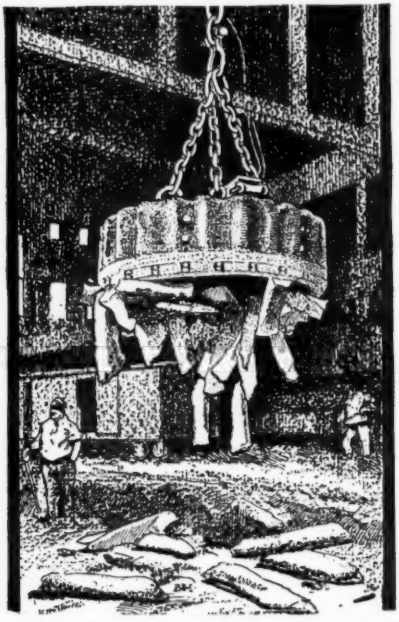

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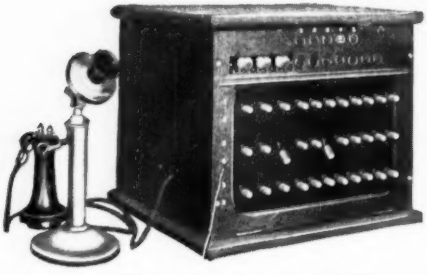

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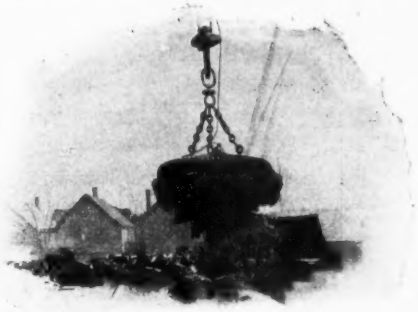

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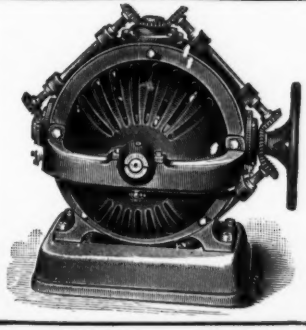

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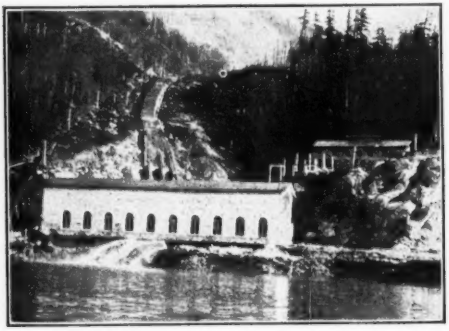

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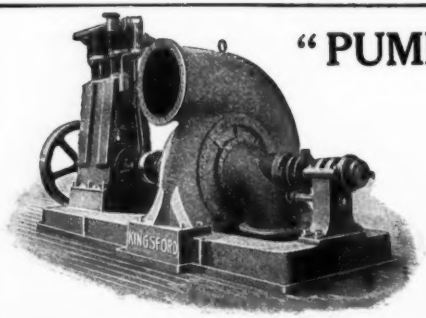

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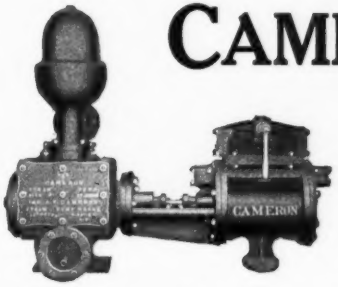

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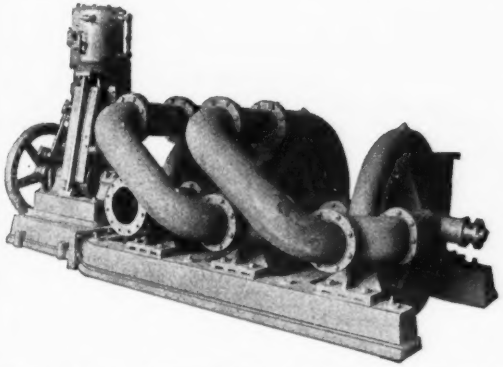

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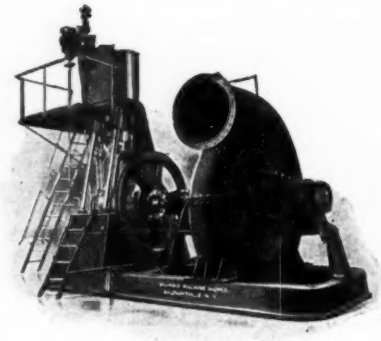

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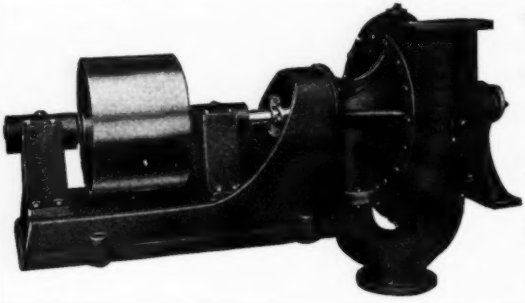

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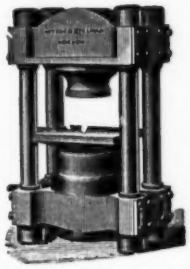

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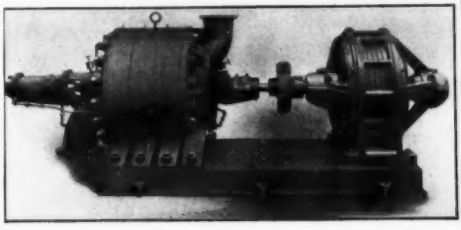

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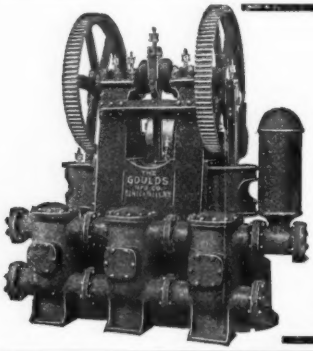

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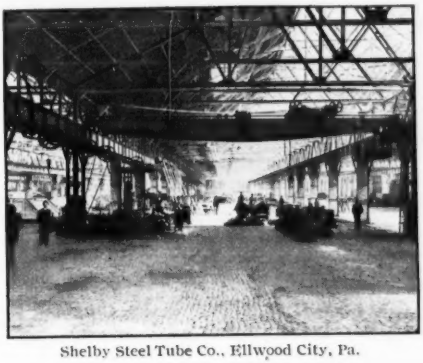

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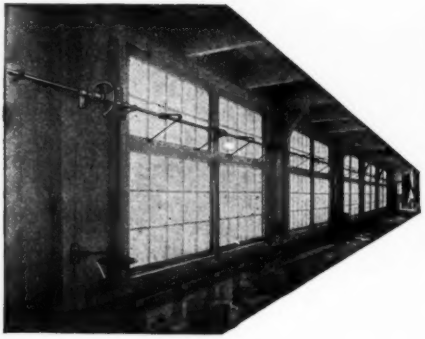

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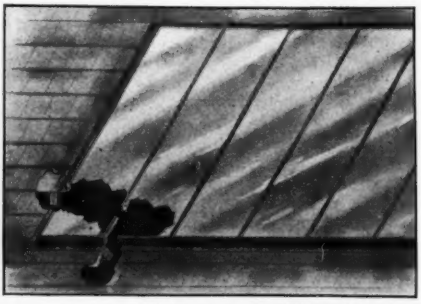

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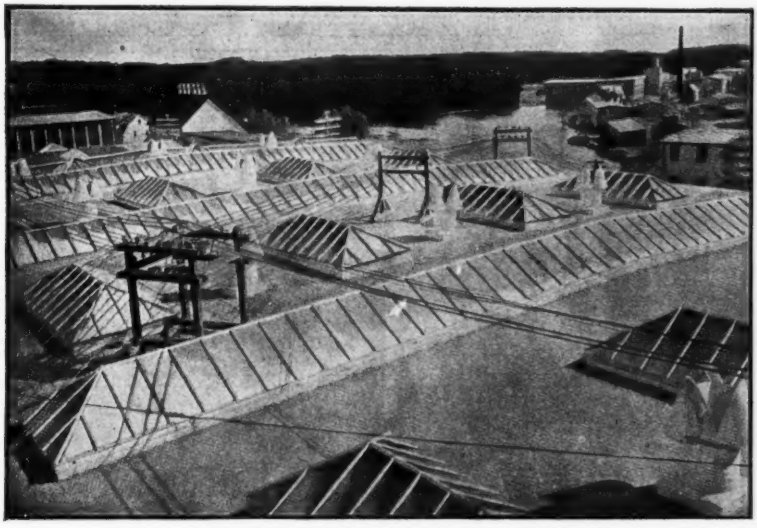

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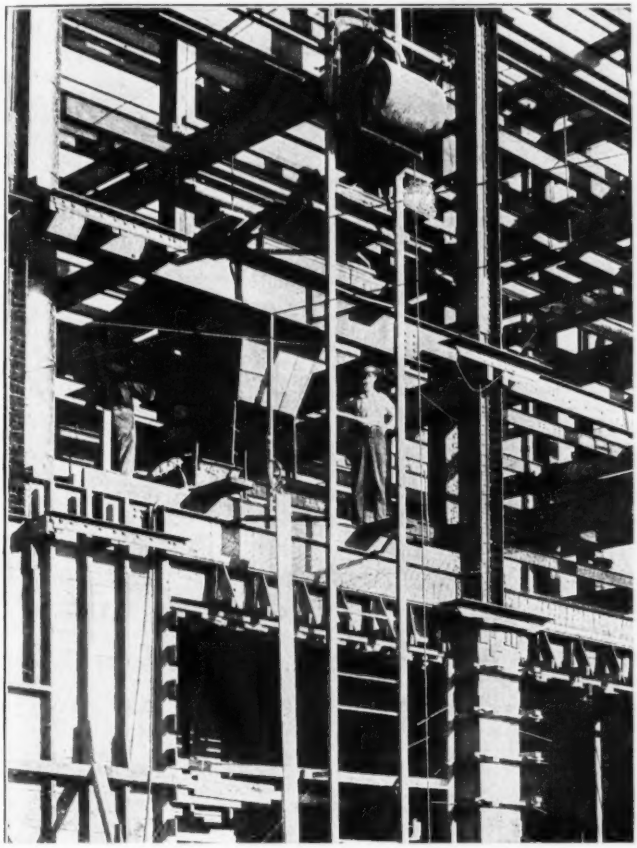

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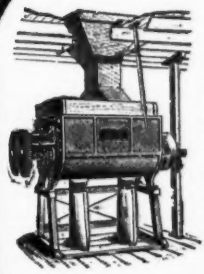

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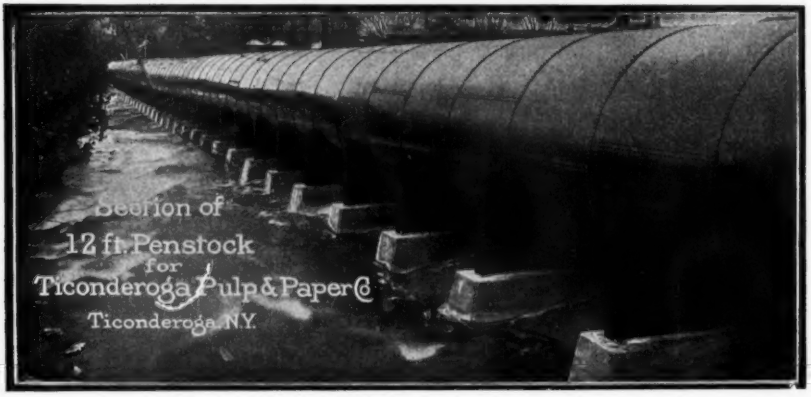

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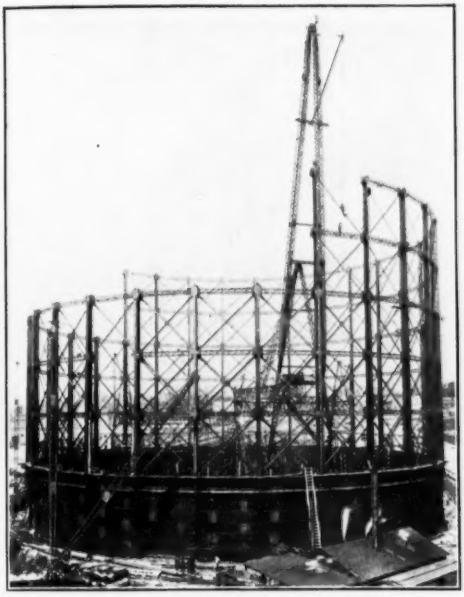

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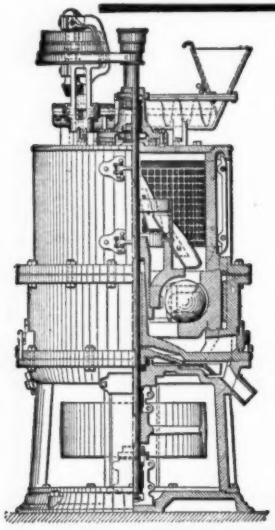

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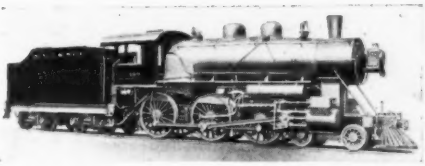

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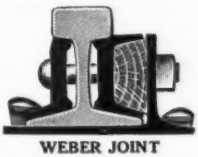

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By EDWIN J. PRINDLE

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The design is especially to lay down the fundamental principles so that they may be grasped clearly and fully enough to direct rightly the course of the inventor, patentee, or manufacturer in the early steps which are usually taken before the advice of counsel is secured. With these points clearly in mind, the procedure may be carried forward so as to avoid the most common pitfalls, and the reader may be clearly warned when and where it is necessary to call in expert advice.

To the inventor and the patentee the most significant portion will be the clear outline of the precautions which should be taken in the preliminary steps, the rules and principles by which safe advance may be made up to a certain point, and the demonstration of the great advantage as well as the necessity for securing competent legal assistance in carrying the matter through the Patent Office. To the manufacturer, equal or greater significance will appear in the demonstration of the great commercial advantages which may be secured by proper use of patents in the shop, in dealing with employees, in the sales office, and indeed in the creation and pre-emption of valuable markets.

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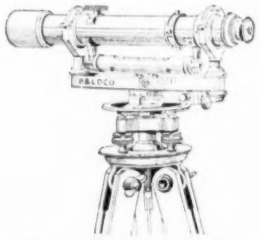

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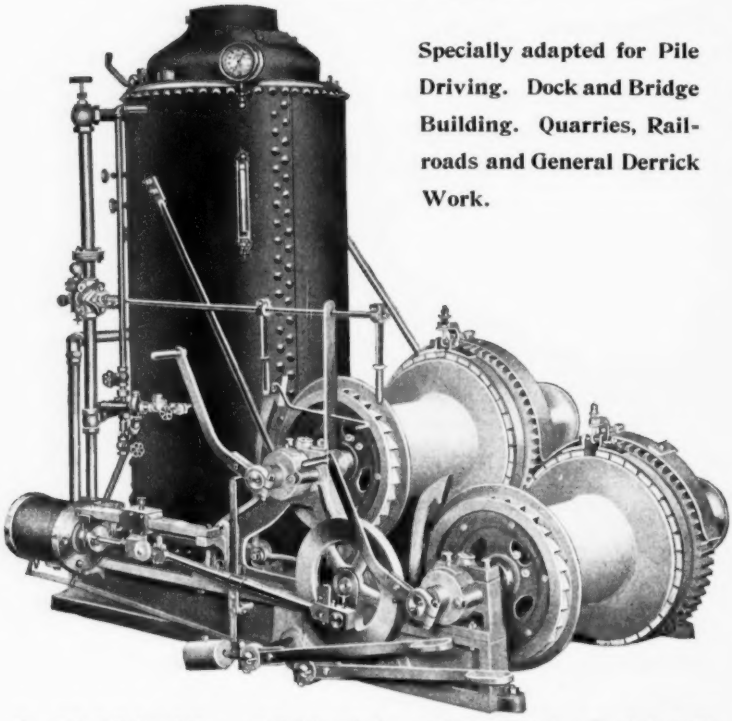

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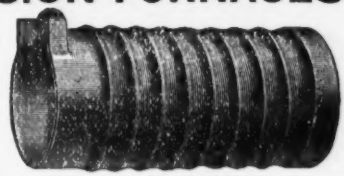

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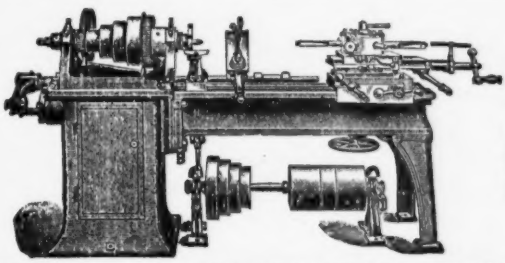

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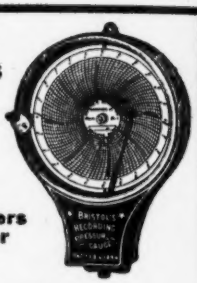

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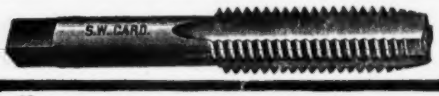

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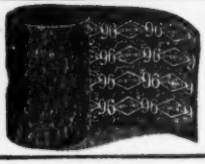

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New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Large Lift Bridge at Cleveland, Ohio.

THE constantly increasing tonnage carried by the internal waterways of the country, particularly along the Great Lakes, has resulted in the last few years in a largely increased size of vessels. The ships of the present day carrying the bulk of the vast tonnage of ore, coal, and grain have the dimensions and tonnage of vessels induced both the federal and local authorities at all the principal lake ports to take steps for the improvement and development of the internal harbor systems afforded by the rivers that had brought to these cities their early prestige as lake ports. The city of Cleveland, Ohio, was one of the

SIDE VIEW OF NEW 230-FOOT SPAN SCHERZER ROLLING LIFT BRIDGE FOR B. & O. R. R. ACROSS CUYAHOGA RIVER AT CLEVELAND, SHOWING MAINTENANCE OF TRAFFIC DURING CONSTRUCTION. SCHERZER ROLLING LIFT BRIDGE CO., CHICAGO.

a length of more than six hundred feet. As the size of the vessels increased, harbor facilities ample to accommodate the lake carrier of a few years before became taxed beyond all possibility of the economical handling either of ships or cargo. This state of affairs and the certainty that the future would bring a further increase in first of the large lake cities to recognize the necessity for improving the river as a means not only of conserving vested interests, but of developing the entire valley of the Cuyahoga river into most advantageous and economical sites for manufacturing industries and railroad terminals.

In a city the size of Cleveland with so

important a navigable waterway through its center the matter of movable bridges has naturally been a subject of important consideration by both municipal and federal authorities. More than 20 bridges, both highway and railroad, now span the river. These structures were originally nearly all of the center pier swing type and for the most part very obstructive to the navigation of the river by large vessels. A policy of new bridge construction along modern lines was inaugurated early in the campaign for an improved internal harbor and has resulted in the removal of a large number of center pier swing bridges and the construction in their stead of the modern type of rolling lift bridge giving a wide unobstructed channel for the passage of vessels.

One of the most important changes in bettering conditions so as to facilitate the handling of vessels of the largest size was the recent reconstruction of the Baltimore & Ohio Railroad Company's bridge across the Old River Bed on the line of West River Street. A long span single leaf Scherzer rolling lift bridge was completed and placed in service at this site a few months ago. It replaced a swing bridge used by the railroad company for many years to reach the extensive ore docks on the north side of the river.

The bridge is a single leaf single track through bridge of the Scherzer type having a movable span center to center of bearings of 230 feet, the longest span single leaf bascule bridge in the world. The clear channel for navigation measured between faces of piers is 210 feet. The total length of steel work including the short plate girder fixed approach span at the rear end of the bridge is 334 feet. The bridge has a width of 20 feet center to center of trusses and a minimum clearance of 22 feet above the ties. The counterweight is of Portland cement concrete carried in steel boxes in the plane of each truss, the bridge being counterweighted so as to be at rest in all positions.

The bridge is operated by two alternating current electric motors of 75 H.P. each, the controller governing the motors being placed in the operator's house. The motors are equipped with solenoid brakes operated by an independent switch on the switchboard in the operator's house. The power is applied in the operation of the bridge by pinions on the main operating shaft engaging with fixed racks placed on independent supports outside of each truss. The operator's house also contains indicators which show to the operator, both day and night, all positions of the bridge during operation. Indicators are also provided showing the positions of the end latch. Signals are placed at each end of the bridge interlocked with derailing switches and with the end latch and main operating controller so that the bridge cannot be operated until these signals have been set at "danger" and the derailing switches opened.

The substructure consists of one front pier, three main piers carrying the track girders on which the bridge rolls and an abutment supporting the rear end of the plate girder approach span. These piers are of concrete carried on piles.

An interesting feature of this work was the erection of the new bridge in its open position without interfering with the railroad traffic over the old swing bridge or the operation of the old bridge for the passage of vessels.

Monel Metal.

MONEL metal is a natural alloy containing from 70 to 80 per cent. of nickel, and having physical properties in castings as shown in the table below.

Monel metal is as non-corrosive as pure nickel, the same in appearance, low in price and suited for any castings which are subjected to severe strain and shock and which must be of a metal that will not corrode. It is specially recommended for such parts of automobiles, motor boats, yachts, steamships, pumps, valves, etc., as

	Grade B.	Grade C.
Tensile strength	85,000 lbs.	65,000 lbs. per sq. in.
Elastic limit	40,000 lbs.	25,000 lbs. per sq. in.
Elongation in 2"	10 per cent.	30 per cent.
Reduction of area	14 per cent.	35 per cent.

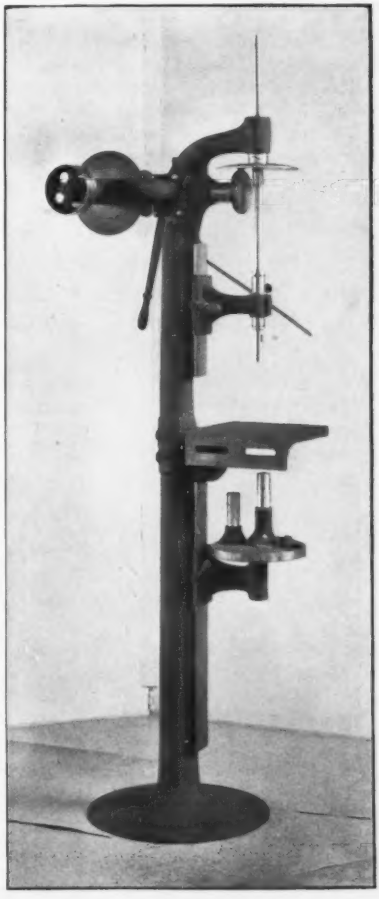
are now being made of various bronzes or white metals. Monel metal castings are sound, clean, and true to pattern and easily machined, and the high percentage of nickel in them insures great strength and toughness. The physical properties cited above are merely those for the two grades mentioned. Greater strength and elastic limit can be furnished if required in the same composition and with the same noncorrosive properties. Isaac G. Johnson & Co., Spuyten Duyvil, N. Y., are well equipped for making castings of every size and description in this metal, which is made by the Orford Copper Company, New York.

New Sensitive Drill Press.

THE Washburn Shops of the Worcester Polytechnic Institute, Worcester, Mass., have recently brought out a variable speed sensitive drill press of an entirely new design and upon which they have several patents pending. The machine has several novel and interesting features not embodied in any machine before placed on the market. Between the driving shaft and the spindle no cones or quarter turn belts are used, the power being transmitted to the spindle by means of a double disk and roll friction designed to give an instantaneous variation of speeds, in which the essential feature is a cam clutch combining a positive drive and tightener which increases or decreases the pull of the disk on the roll directly as the work requires. This action is entirely automatic. The pressure between the rolls and disks being very slight except when drilling.

The variation of spindle speeds is obtained by throwing a lever attached to a segment gear which meshes into a rack cut on the roll carrier, the extreme movement of the rack being only two inches for a range speed from 4 to 1. This sliding of the rolls across the disks is easily accomplished as there is but very slight normal pressure on the rolls except when drilling, so that there is no excuse for not running the drill at exactly the proper speed.

No counter shaft is required with this machine. To stop the spindle, the speed lever is thrown to its extreme position and while in this position the driven roll is out of contact with the driving disk, the disk being recessed for this purpose. The elimination of the counter shaft from the multiple spindle type is especially advantageous, not only in the ease with which the variations of spindle speeds may be obtained without the trouble of shifting belts, but each spindle may be started or stopped at will independently of any other spindle. The design also presents a much neater



appearance than is possible in any multiple spindle drill press which depends on cones and quarter turn belts to transmit its power.

Each head of the multiple spindle type is a unit in itself and the heads may be slid along the column to as close as 10" centers. Any head may be taken from the column or extra heads added as the work requires. The head is fastened to the column by a tee bolt set at an angle and the head is drawn into position by the lever nut showing in the cut at the rear of the machine.

The disks are of cast iron and the rolls of fiber. The spindle has a travel of 3" and the head a vertical adjustment of 7½". The diameter of the spindle in the sleeve is ⅞" and is bored to receive a No. 1 Morse taper. The single spindle machine weighs about 250 pounds, the two spindle 450 and the three spindle 650.

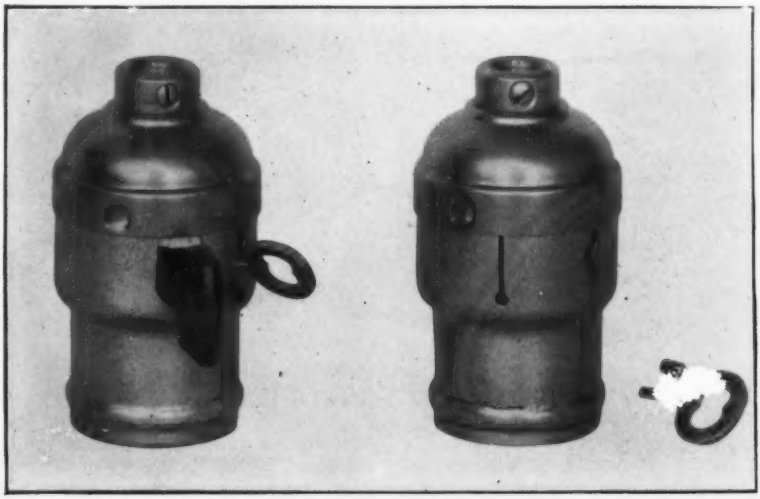
The drill press is no experiment, having been thoroughly tested for several months by every day use at the Washburn Shops. It is designed for sensitive drill work and will carry both carbon and high speed drills up to 9/16" at their proper speeds and feeds.

A New Locking Socket.

A SPECIAL lamp socket has recently been placed on the market by the General Electric Company, which should prove a boon to hotel managers, factory owners, managers of amusement resorts and others who suffer lamp losses by petty thievery. In the old style of locking socket the lamp was held rigid in the socket and attempts to remove it generally resulted in breaking the globe. In the new style the screw shell turns freely and the lamp cannot be removed until the shell is locked with the key. The socket is shown in the accompanying illustration, and it should be noted that the addition of the locking feature has been made without detracting in any way from the neat appearance of the standard socket. This locking socket should also appeal to those who had contemplated using the higher priced tantalum and tungsten lamps, but who had deferred doing so on account of the extra inducements offered to the sneak thief.

A New Departure in Fan Blowers.

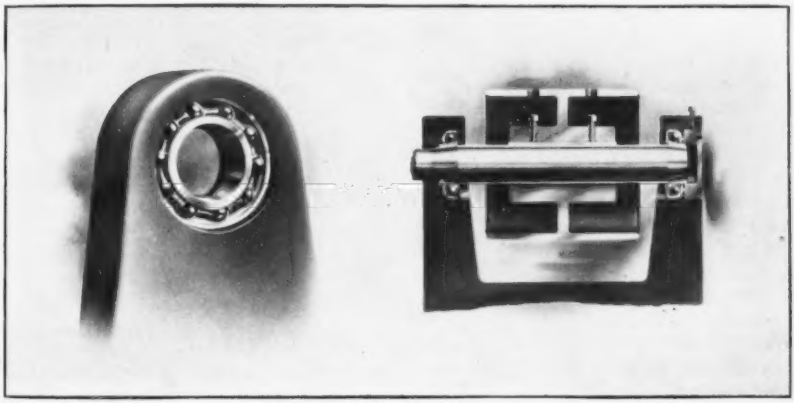
A NEW departure in fan blower design has been made by the Massachusetts Fan Co., of Watertown, Mass. Ball bearings are used in place of the usual babbitted journals, with a consequent friction reduction of at least 85 per cent. The bearing is of the Chapman type. In large sizes it is made up of a circular containing ring into each side of which are set case hardened cups. A sleeve is slipped through the



KEY AND KEYLESS LOCKING SOCKET FOR ⅛" PIPE FOR EDISON SCREW BASE LAMP.

center, and a case hardened cone is forced on at each end. Between the cups and cones run hardened steel balls separated by small idler balls held on the circular center line by means of steel floats. The bearing proper is enclosed in a frame or housing within which it is supported on the ball and socket principle. The shaft is then slipped through the sleeve, the contact being a good sliding fit, leaving the sleeve free to turn with the shaft, or the shaft to turn with it. The idler ball eliminates the grinding action usually found in ball bearings. Each bearing is packed in vaseline when shipped from the factory, and requires no attention whatever except a semi-annual repacking. This is effected by removing the dust proof washers and applying the vaseline directly to the balls.

overhung upon the end of the shaft. The bearings, both upon one side of the fan, are of similar make, but of single ball races instead of double as in the larger fans. The different parts of both types of bearings may be readily dissembled for inspection or replacement, but as each is subjected to a severe running load before acceptance this is rarely necessary. The small exhauster type is made universally convertible, that is, it may be adjusted to discharge in any direction without resort to a change of hanger, and with equal ease it may be made either right or left hand or inverted without reference to the bearings, for which special oiling arrangement would be required in other types. The same hanger is used on both single and double exhausters.



In order to detect any defective parts each bearing is run under a hydraulic pressure of several tons after assembling. Such bearings have been run for months under various conditions without showing the slightest sign or wear or deterioration.

The bearings are supported in the ordinary manner on rigid angle iron uprights which carry a cross bar extending between the main fan braces, the fan housing being made of any form to meet the requirements. There is perfect freedom from risk of fire, odor or pollution of the air, and above all no care is required. The fans may be placed in conspicuous places without collecting dust due to escaping oil.

In the smaller type, those with a 60 inch height of shell and less, the blast wheel is

By a recent extended series of tests it was shown that the power required by a ball bearing fan averaged only about 90 per cent. of that required to run the same fan when equipped with ordinary babbitted bearings. Both fans were brought down to working conditions by several weeks run before the tests were made. The decrease in power is roughly equivalent to annual saving of about 25 per cent. of the cost of the fan.

Erwood's Reversible Rolling Shutter.

THE advantages attained in the use of shutters composed of independent slats of metal, each hooked to the other, are especially apparent in closing large

openings such as confront us in roundhouses, shipping platforms, wagon ways and fire walls, core and drying ovens, etc. They occupy a limited space over the opening on either side and are readily operated by either a light chain or automatic fusing link, as required.

Doors of this type have of late years found favor in connection with large core oven and dry kiln work where a fireproof and fairly air tight closure is sufficient.

Core ovens of 20 feet in width at the opening and subjected to the ordinary temperature of such a service have been successfully sealed in this way. In the ordinary rolling shutter, however, the slats are formed hook or S shaped and consequently but one side of this combination is water and dust proof, as is obvious in hooking two such shapes into each other. While it has been the custom to place the weather side outward and thus shield the hinges from the elements and dust, the inside or reverse side wherein the hinge is exposed by the open groove, has been exposed to all the objections of wear and corrosion entailed by the admission of moisture and dirt, conditions not possible to remove or prevent in shutters constructed in the old way.

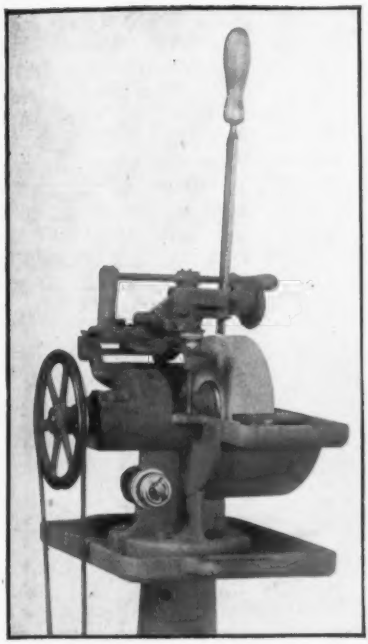
One of the features in the Erwood reversible shutter is not only to remove this difficulty, but to place before the shutter using public a reversible device with both sides weather proof. The illustration shows a slat of individual construction, but different methods of a compounded slat have also been fully detailed by the inventor, together with other features of operating mechanism. In the sketch it will be observed that what would constitute the reverse or inside of the slat or shutter is protected and shielded by means of a shield composed of the same sheet as constitutes the entire slat, the shield extending over the opening of the hinge and acting as a water shed extending down to the center of the hinge and preventing drip or dust from lodgment in the vital part of the shutter. This invention permits of the use of a flat web to the slat, which in rolling closely to the winding mechanism occupies not only less space but also lighter counterweighting as the shutter is rolled up.

The shutter is the invention of John Erwood of Chicago, the inventor of the Erwood swing gate valve.

Revolving Oilstone Scraper Sharpener.

THIS machine was principally designed for the purpose of properly sharpening machine scrapers. The old method of sharpening by rubbing them over an ordinary bench oilstone requires considerable time and an experienced man to put a scraper in shape that it will take hold to the surface being scraped. An ordinary man or boy, by using the scraper sharpener, will not only sharpen the scraper quicker and better but will sharpen it in such a way that it will cut better and longer without sharpening. The machine also sharpens it in such a way that an inexperienced man can get the greatest efficiency out of the tool. The machine will grind the face perfectly straight or slightly convexed if so desired, always making sharp cutting edges on the two edges. For grinding the edge, the scraper is held in a vise which is attached to compound slides, and by the use of the hand lever the vise and scraper are moved back and forth, as well as laterally across the face of the stone. By these two motions the scraper is moved over the whole face and always keeps the stone worn straight. For gripping the scraper quickly and accurately in the vise there is provided a small platform which is always in the line with the face of the wheel and parallel with the lines of motion of the two slides. Therefore to grip the scraper simply push the vise over the platform, set the scraper on it and clamp the vise by turning the small hand wheel, then slide the vise laterally forward until the scraper comes over the stone. This can be very quickly and conveniently done. The feed is regulated by the adjusting screw at the front of the machine.

Other purposes for which the grinder can be used in machine shops is touching up and putting a keen smooth edge on thread cutting tools or any other tools on which a keen smooth edge is required.



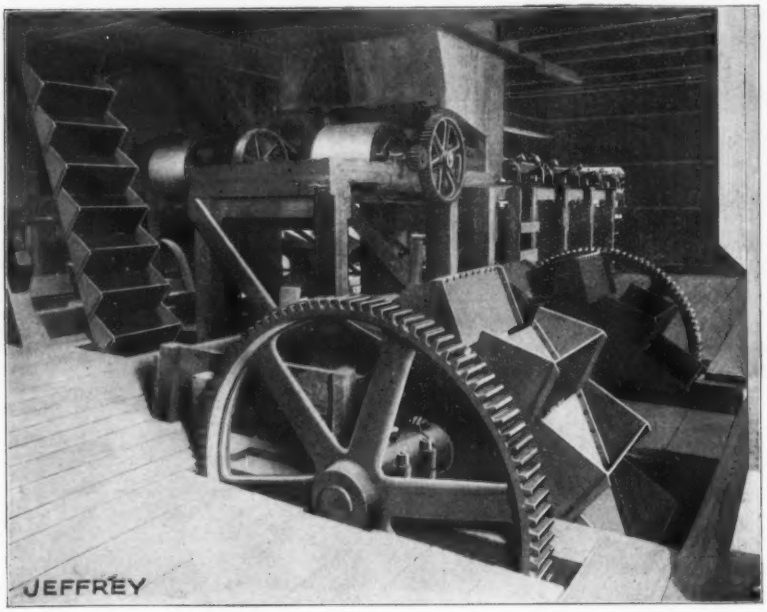
When doing work like this the scraper holding the attachment can be thrown back out of the way. The oilstone wheel is run in a bath of kerosene, which prevents heating the tool and keeps the surface of the wheel clean and sharp, not permitting it to glaze. It is driven through a set of spur gears with a ratio of two to one making a very powerful drive. Arrangements are made so the stone will not throw any oil. The machine is furnished with counter shaft for belt or motor drive. The machine is portable and it is provided with two handles by which it can be easily carried by two persons and placed anywhere on the floor close to the work on which the scraper men are working. It is made by Mummert, Wolf & Dixon Co., Hanover, Pa.

Stone Elevators and Conveyors.

ONE of the largest and best equipped stone crushing and shipping plants in America has recently been completed by the Cedarcliff Stone Company at its works near Cedarcliff, N. Y. An exceedingly interesting and important feature of this plant is the very complete system of elevators and conveyors by which the stone is handled throughout the numerous processes of preparation and shipment. This system may be divided into two parts: First the series of elevators and conveyors which take the stone from the crushers to the revolving screens and from thence to the storage grounds, and second, the series which deliver the sized product from the storage grounds to cars or vessels as the case may be. The first system consists of three elevators and two belt conveyors. Each of these elevators is 65 feet high from center to center of wheels. They all are of the general types illustrated and are the same in construction and dimension of parts. Two of these elevators stand side by side and are so located that they handle the product of a No. 9 Gates crusher and four of No. 6 size. The stone from each elevator is delivered into a revolving screen from which the tailings go back to two No. 6 crushers on each side and are recrushed. Everything which passes through the screens is received by the third

elevator which stands directly in the rear of the other two, and which delivers it to the finishing screen in the top of the building.

The finishing screen separates the stone into 2-inch and ¾-inch products and the screenings which pass through a ⅜-inch hole. The screenings are carried by a 14-inch Century belt conveyor to the north of the building, a distance of 100 feet. The 2-inch and ¾-inch products are conveyed to the storage grounds at the south of the building by two separate belt conveyors, the belt for the concrete stone being 24 inches and the other 18 inches in width. These conveyors to the storage ground discharge the stone by means of an automatic tripper into the proper compartments for each class.



The plan of ground storage adopted by the Cedarcliff Stone Company is something unique in stone crushing plants and is, so far as we know, the first in which this arrangement has been adopted. Most stone crushing plants deposit the stone in large bins which are not only costly to erect but must be maintained at heavy expense. This ground storage plan is precisely the scheme commonly used for storing coal. The storage ground is 160 feet long by 100 feet wide, and the distributing conveyors are placed at an elevation of 35 feet, so that the storage capacity is about 8,000 cubic yards. The distributing conveyors over these grounds rest on concrete columns placed 35 feet from center to center, each column being 12 feet by 7 feet in plan, and having a ventilating shaft 8 feet by 3 feet in its center from top to bottom. Beneath the column in the center and running the entire length of the storage ground there is a conduit or tunnel cut out of the solid rock. The cross section of this tunnel is 8 feet by 8 feet inside measurements and its length is 160 feet. The walls and floors are of concrete while the roof of the tunnel is formed of 12-inch I-beams set 2 feet apart and filled in with concrete. In this roof bit-gates are located six to eight feet apart the entire length. Oven the tunnel, stone will be piled to a height of 35 feet.

For conveying this crushed stone to railway cars or barges, a 36-inch belt conveyor travels the entire length of the tunnel. By opening one of the bin gates described, the stone from above falls onto the belt conveyor, which delivers it to an elevator 45 feet centers. This discharges onto another belt conveyor 36 inches wide by 200 feet

long, which carries it over the railway tracks to the wharf at the river's edge. The stone from this conveyor is discharged by a tripper either at the wharf for loading vessels or into a small pocket overhanging the side tracks of the West Shore Railroad Company, where it is loaded onto railway cars. This system of loading conveyors is designed for a capacity of about 400 tons per hour, and is operated by an independent engine so that the barges or cars can be loaded without reference to the operation of the main plant.

A conspicuous feature of this elevating and conveying scheme is the great strength of the elevators. The buckets of all are 30 inches in length and are sustained by two parallel chains especially designed and made up for the heaviest possible work. The chains are the Michigan type of the Jeffrey climax steel chain, except that they are made double width in order to give greater bearing surface on the head and foot wheels. They are designed to carry a steady load of from six to seven tons, and as a factor of safety of about 15 is allowed it is reasonable to suppose that there will never be any serious trouble even though the conditions under which they work are necessarily severe.

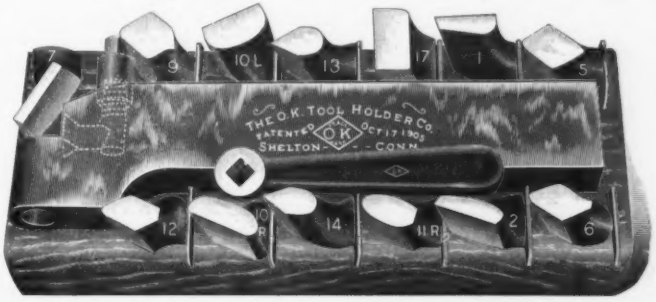
The entire elevating and conveying system was installed by the Jeffrey Manufacturing Company, Columbus, Ohio.

O. K. Planer Sets.

THE O. K. system of lathe, planer, shaper and boring-mill tool holders offers the advantages of a solid forged cutting tool combined with the most economical use of steel, particularly when the high priced high-speed steels are employed. An accompanying illustration shows the O. K. standard boring-mill set. Owing to the fact that boring mill cutting tools must necessarily be short a solid forged tool can only be reforged two or three times, which makes the cost excessive when high-speed steel is used. The O. K. system of holder and cutting tools permits the changing of the cutting tool on the work without loss of time, and as the holder lasts indefinitely the only expense is the replacing of worn-out cutters with new ones. Owing to the great variety of boring mills the O. K. Tool Co. are prepared to make their holders in any size and drop to suit different mills. Their standard set consists of a holder, block and twelve assorted high-speed steel tools.

The O. K. lathe dogs are steel drop forgings, case hardened, with set screws and removable jaws made of tool steel carefully hardened and tempered. The end of the set screw is protected from upsetting or bending and the work is gripped between two V blocks which do not mar the work. They are also furnished with jaws made like a pipe vise with teeth for gripping rough stock for high-speed turning, or they may be had with brass jaws at a slight advance in cost.

The makers are the O. K. Tool Holder Co., Shelton, Conn.



Activity of the Cement-Making Industry.

SEVEN powerful Corliss engines designed for installation in a single industrial plant, with electric generator, motors, transformers and a full complement of auxiliary apparatus, including a separate condenser for each of the engines, constitute an order which is notable at any time

and particularly so at present; for this enormous quantity of power machinery, now being built and installed by Allis-Chalmers Company in cement mills at Nazareth, Pa., operated by the Atlantic Portland Cement Co., indicates something of the proportions which the cement-making industry is assuming and the prominent part that it now plays in the commercial activity of the country. Allis-Chalmers Company has, for many years past, been leading manufacturer of cement making machinery, and the fact that it also builds power, electrical and transmitting machinery puts the company in a position to equip completely every department of a cement plant, from the so-called "raw mill," where the material is first treated, to the "finishing mill" in which the product is turned out for shipment. During the past twelve or fifteen months there has been great activity in this line, and orders carried over into the new year, together with contracts recently placed for equipment that is urgently needed, show a relatively healthy condition of trade which contrasts strongly with the continued inactivity in some less favored industries.

New Shaper Cross Feed.

THE accompanying comparative illustrations graphically illustrate the advantageous features of the new front cross feed which Gould & Eberhardt, Newark, N. J., are putting on the market as an attachment to their well-known line of high duty shapers. This new front cross feed is intended principally for tool room and die work where the job requires both down and cross feeds to follow a given outline. Fig. 1 shows the contortions necessary with the standard shaper in order to use both feeds and keep an eye on the line. The new front cross feed which the manufacturers have designated as "the natural way" is shown in Fig. 2. It is claimed that this feed will not only enable the workman to turn out better and more accurate work, but it also permits of a less fatiguing position at the machine. This addition to the already long list of shaper improvements put out by Gould & Eberhardt, is patented, and controlled by them.

FIG. I.

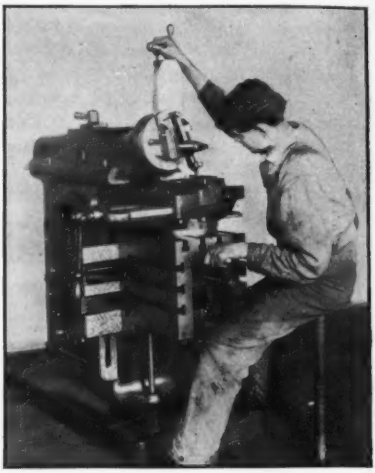
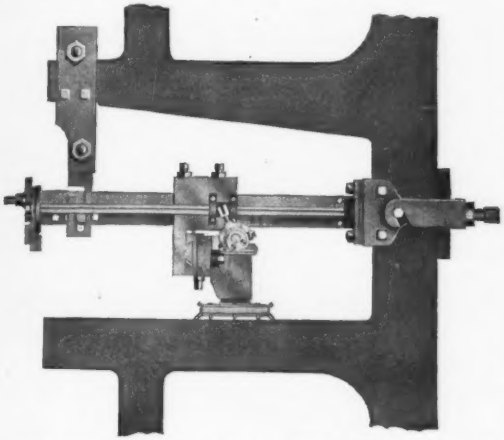


FIG. 2.

Locomotive Pedestal Facing Machine.

THE accompanying illustration is so clear that the reader should have no difficulty in understanding the practical points of the facer, whose parts are easily and quickly kept true. At the top of the square bar is a steel swivel, allowing the cutting tools to be placed for either leg. There is also a swivel to allow for the angular side of the shoe. The top of the swivel is a large surface which clamps firmly to the frame and is easily changed to allow the device to work on narrow spaces. In one side of the square vertical bar or

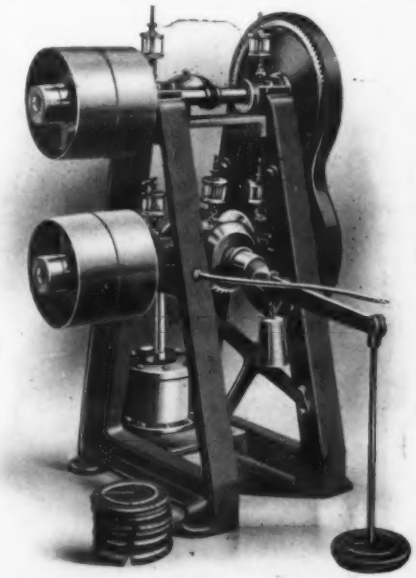
slide for the milling head is a steel square-thread feed screw. The milling head has a bronze half-nut engaging the feed screw to a ratchet and pawl for change of feed. The feed is operated by an eccentric on the milling head, driving the vertical shaft and making it automatic and variable to



suit the requirements. As the milling head has two adjustments, to and from the leg and across the face, it allows fine and quick adjusting without knocking or loosening any part. A suitable crank is furnished with it. At the lower end the universal adjustable clamps securely hold the device firmly and rigidly to the frame. The power is applied to gears turning the milling spindle. This is threaded to receive the milling cutters, which are made of square high speed steel, and are removable for grinding and adjusting. The means of applying the power is by a telescopic shaft having universal tumbling joints at each end, which allows the power to be placed in a convenient and out of the way place, eliminating belts, etc. A large quantity of metal can be removed in a short time, not by one pass, but by taking light cuts, as the time consumed in each transit is very short. A very complete rig for driving this and their other portable tools is their two cylinder air or steam motor, which in itself is an admirable machine. It is made by H. B. Underwood & Co., 1027 Hamilton St., Philadelphia.

Lawrence Balance Dynamometer.

THE Lawrence balance dynamometer for weighing transmitted power is particularly adapted for testing machines already installed to get the amount of power consumed by the individual machine. Its peculiar advantage is that it is not necessary to displace the machine being tested and the power consumed by the machine can be weighed when it is in actual operation and doing its work. The dynamometer being placed near the machine, the regular driving belt is carried to the dynamometer and a short belt is used from the dynamometer to the machine itself. It is particularly adapted for experimental work in laboratory and experimental rooms for all types of machinery, or in technical schools. It can also



be used to very good advantage in testing gas engines and small steam en-

gines to find the power they will develop at the different speeds. It is built in three sizes, weighing power up to 50 horse power. One advantage of this machine over testing which is sometimes done by an electric motor is that the efficiency of the machine does not have to be guessed at, as in the case of a testing motor. Numerous tests of the machine have shown the error, if any, to be remarkably small, and in tests of machinery taking small amounts of power, but in totals aggregating 250 horse power, have agreed within 2 per cent of the results from indictor cards of engines driving the same machinery.

Motor Drive in an Emergency.

AN interesting incident showing new advantages of motor drives turned up recently. A large Ohio paper mill ordered several engine type generators of the Northern Electrical Mfg. Co., Madison, Wis. Through an oversight the customer did not specify who should mount the armature on the engine shaft, and thus neither the engine builder or dynamo manufacturer made provisions for mounting the armature. When this was discovered after erecting operations had begun it was found that no jobbing shop was in a position to handle a force fit of about 150 tons. Accordingly the Northern Electrical Mfg. Co. shipped from its works one of its motor driven hydraulic presses, with necessary rigging for pressing the armature on the shaft. A small generator was rigged up to furnish current, and the job of pressing completed in short order. Had not the portable motor driven outfit been available, considerable delay would have been necessary, and much expense to ship the armature and shafts to the engine builder's factory for mounting.

NEWS SUPPLEMENT

The Engineering Magazine—April, 1908

Personal.

—Joseph G. Branch, formerly chief engineer of the City of St. Louis, has taken charge of the scientific department of Rand, McNally & Co., Chicago.

—Philip J. Nash has taken charge of the sales department in Chicago, of the Ernst Wiener Co., New York. Mr. Nash has long been in the industrial railway business and is a technical and practical man. The offices are located at 863 Monadnock Building.

—Arthur D. Little, chemical engineer of Boston, has just been re-elected official chemist of the American Paper and Pulp Association, at the recent meeting of which he read a most enlightening paper upon recent developments in the manufacture of paper and pulp.

—Alfred A. Wohlauer announces that he has opened an office at 500 Fifth Avenue, New York, and is prepared to investigate and report upon all matters relating to electric light and heat; to design and supervise electric light and heat installations and to advise as to the possibilities with new propositions and as to the extension and improvement of existing installations.

Industrial Notes.

—Hammond Iron Works, Warren, Pa., has issued a tankage scale, giving the capacities of steel tanks up to and including 5,500 barrels.

—Lenher Engineering Co., sales agents for the Taylor gravity underfeed stokers, announce the removal of their offices from 39 Cortlandt Street to the Singer Tower, 149 Broadway, New York.

—At the recent annual meeting of the stockholders of the Massachusetts Fan Co., Watertown, Mass., Horace Chenery was elected president, and D. K. Bartlett, treasurer. Mr. Bartlett will have general charge of sales and manufacture.

Ridgway Dynamo & Engine Co., Ridgway, Pa., builders of automatic engines and dynamo electric machinery, have opened a district sales office at 907 Andrews Build-

ing, Cincinnati. George W. Euker will be in charge as manager.

—George P. Hutchins has moved from 500 Fifth Ave. to 11 West 32nd Street, New York, where he will be associated with the Homer W. Hedge Co., general advertising agents, and will manage the technical department of their business.

—Among recent orders received by the Massachusetts Fan Co., Watertown, Mass., for equipment for schoolhouse ventilation consisting of fans or complete heating apparatus, are Public School No. 129, New York City, Lawn School and Delason Ave. School, Cleveland, O.

—The Fidelity & Casualty Co., 97 Cedar Street, New York, have issued two booklets treating of fly wheel insurance and engine inspection and steam boiler inspection and insurance, in which much valuable information regarding these forms of insurance are given.

—The Massachusetts Fan Co., Watertown, Mass., is furnishing equipment in the way of fans and heaters for the Eastern Maine Insane Asylum, Bangor, Maine, Office Bank and Library Co., Boston, the Memorial Building, Dayton, Ohio, and the Norwich Hospital for Insane, Norwich, Conn.

—Through a "kink" somewhere in the chain of communication, the data which reached us for the description of the installation shown in the upper picture on page 919 of our March issue defined the generators as being "G. E." This is an error, the two generators in the Traction Terminal Building, Indianapolis, illustrated in the photograph, being of the Western Electric Company's manufacture.

—The Massachusetts Fan Co., Watertown, Mass., are furnishing for the Clarendon Clay and Mining Co., North Clarendon, Vermont, a complete hot blast outfit for drying Kaolin. The apparatus consists of a steam heater and one of the Massachusetts ball bearing fans. The adaptability of the type of fan is shown by the fact that when the balls are once packed in vaseline no further attention is required for at least six months.

—The United Gas Machinery Co. have taken offices in the Engineering Building, 114-118 Liberty Street, New York City. They have taken over the business formerly conducted by Thos. F. Fitzsimmons at 100 Broadway, and will manufacture a complete line of gas generators for making producer gas for gas engines and heating, and water gas for high temperature furnaces, forges, annealing, etc. Thos. F. Fitzsimmons remains with the company as its president and general manager.

—J. A. & W. Bird Co., 34 India Street, Boston, have issued two text books on Power Transmission which are the first of a series of six similar books. Nos. 1 and 2 treat of Belt Drive Design and the Power of Belting respectively. The remainder of the series will deal with such topics as Quarter Turn Drives, Shafting Designs, Miscelaneous Notes on Belting, etc. These booklets will be of a uniform size and have a device on the covers which will enable them to be joined together in a single, compact work of reference.

—During January, the Duquesne Steel Foundry decided to adopt the gas power system to operate the works formerly driven by steam. The initial equipment will consist of a 400 H.P. (max.) Westinghouse gas engine of the three-cylinder vertical enclosed type, direct connected to a 240 Kw. generator which will serve the various motor drives around the plant. The plant will operate on natural gas, which is available in large quantities in the Pittsburg district for power as well as lighting.

—The American Society of Mechanical Engineers with the desire to still further develop their publications, have secured Lester G. French to direct their editorial department. Among the immediate improvements to be undertaken is the establishing of departments in the monthly Proceedings, thus providing a greater variety of technical articles of interest. Many other features are also planned. All such papers, however, will first be presented and discussed before the Society at its meetings, as formerly, thus benefiting the membership twofold.

—Among recent sales in the line of steam specialties The Ohio Blower Co., Cleveland, O., report the folowing: To the Tower Hill-Connellsville Coke Co., Uniontown, Pa., two 12-inch cast iron exhaust heads, one 5-inch horizontal separator, two 10-inch horizontal separators; Ellingsburg

Washington Normal School, Seattle, Wash., one exhaust head; Lee-Huckins Hotel Co., Oklahoma City, Okla., one 10-inch exhaust head; Merchants Ice and Cold Storage Co., one 5-inch horizontal steam separator; Knott-Van Arnam Mfg. Co., Fort Wayne, Ind., one 6-inch horizontal oil separator. Also a number of ammonia separators for use in connection with ice manufacture.

—The next monthly meeting of The American Society of Mechanical Engineers will be held in the auditorium of the Engineering Societies Building, New York, on the evening of April 14. The general subject of the meeting is The Conservation of our Natural Resources, which is now receiving unusual attention, because of the invitation of the President of the United States to the governors of the several states, and to the presidents of the national engineering societies, to confer with him in Washington on this important problem. The New York meeting will be addressed by four speakers who will consider forest preservation in its relation to water power, economy in the utilization of fuels, and the attitude of the engineer in regard to these. Dr. Henry S. Pritchett, president of the Carnegie Foundation for the advancement of teaching, will be one of the speakers and will discuss the "Relation of the Engineer to the Body Politic."

—The Westinghouse Machine Company, builders of the Roney mechanical stoker, reports for the first two months of this year a good demand for stoker equipment. Perhaps the most interesting orders have come from cold storage companies. The Merchants Ice & Cold Storage Co., Cincinnati, are installing three equipments; the Montgomery Ice & Cold Storage Co., Jenkintown, Pa., two equipments; and the Molt Ice & Cold Storage Company, Indianapolis, the same number. Another municipal lighting station at Troy, Ohio, operated by the Board of Public Service, has adopted Roney stokers, and the Pennsylvania Light, Heat & Power Co., Allegheny, operating a large central station at that place, increases its present equipment with two stokers of large capacity. The Mutual Union Brewing Co., Alliquippa, Pa., is installing three equipments, and the Alpha Portland Cement Co., operating a number of plants in the country, one of the largest size.

NEW CATALOGUES AND TRADE PUBLICATIONS

Note.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.

Boilers.

Murray Iron Works, Burlington, Iowa.—Catalogue No. 60, describing safety water tube boilers. Also contains views of a few buildings in which these boilers have recently been installed. The catalogue is well printed and handsomely illustrated. 12 by 9 in.; pp. 40.

Chains.

Link-Belt Co., Philadelphia—Catalog No. 75 is devoted to an illustrated description of chains for all classes of service. Sprocket wheels and gearing are also given a place. 6 by 9 in.; pp. 208.

Chucks.

Cushman Chuck Co., Hartford.—Catalogue and price list containing an illustrated description of chucks specialy designed for lathes, drilling machines, boring and turning mills, milling machines, etc. 4 by 7¼ in.; pp. 48.

Contractors Machinery.

Parker Hoist & Machine Co., Chicago.—Catalogue No. 20 is devoted to an illustrated description, with tables giving sizes, of derricks and hoists of all descriptions. Also contains numerous testimonial letters. 5 by 7 in.; pp. 72.

Conveyors.

Jeffrey Manufacturing Co., Columbus, Ohio.—Catalogue treating of rubber belt conveying machinery. Illustrated with many views showing recent installations. Also contains price list. 6 by 9 in.; pp. 48.

Electric Motors.

Northern Electrical Mfg. Co., Madison, Wis.—Booklet devoted to a brief illustrated description of variable speed motors. Also contains some facts about the single voltage variable speed system. 3½ by 6 in.; pp. 12.

Sprague Electric Co., 527 W. 34th St., New York—Bulletin No. 310 illustrates and describes direct-current electric motors for operating ventilating fans and blowers. 8 by 10½ in.; pp. 28.

Electric Supplies.

Western Electric Co., Chicago—Large, cloth bound, catalogue illustrating and describing such

electrical apparatus and supplies as are constantly in demand, together with prices. The book is fully indexed. 7½ by 10 in.; pp. 838. Also Bulletins No. 5910-2 and 5910-3 treating of power equipment for boot and shoe factories and cement mills respectively. Illustrated with many views showing recent installations. 7½ by 10½ in.; pp. 24.

Engine Indicators.

TRILL INDICATOR CO., Corry, Pa.—Catalogue describing indicators, both inside and outside spring types; reducing wheels and planimeters. Contains numerous testimonial letters from engineers of this country and Europe, and a chapter giving much handy and useful information about taking and reading indicator cards. 6 by 9 in.; pp. 32.

Fan Motors.

WESTERN ELECTRIC CO., Chicago—Bulletin No. 5352 contains an illustrated description, with prices, of desk, bracket and ceiling fans. The bulletin is well printed in two colors. 6½ by 9 in.; pp. 44. Also Bulletin No. 5910-1 treats of power equipment for railroad shops, and is illustrated with views of shops showing tools operated by individual electric motors. 7¾ by 10¾ in.; pp. 32.

Feed Water Heaters.

GRISCOM-SPENCER CO., 90 West St., New York—Catalogue illustrating and describing the Reilly multicoil feed water heaters. Evaporators, condensers, water filters, and grease extractors for removing oil, grease and other impurities from feed water are also briefly described. The catalogue also contains rules and tables showing the calculations and results to be secured from the installation of feed water heaters. These tables are figured for several different kinds of steam plants, for several different values of coal and for various initial temperatures of feed.

Fuel Economizers.

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—Catalogue bearing the title "The Book of the Economizer" not only describes the history and methods of the Green fuel economizer, but also such engineering topics as the absorption of heat by different parts of the boiler surface; the relative economy of boiler surface and economizer surface under various conditions; methods of determining the economy of additional heating surface from the load curve; the effects of oil fuel, high steam pressures and superheat on boiler economy; methods of measuring the temperature of flue gases; and reports of various tests of boiler plants containing economizers. This book will be of interest and value to all who manage, design or operate steam power plants. Illustrated. 6 by 9 in.; pp. 160.

Gauges.

SYRACUSE STEAM GAUGE MFG. CO., Syracuse, N. Y.—Catalogue describing gauges for all purposes, recording instruments and thermometers, together with tables giving sizes and prices. Illustrated. 7 by 10½ in.; pp. 52.

Gears.

BOSTON GEAR WORKS, Norfolk Downs, Mass.—Catalogue E1 containing an illustrated description, with prices, of gears, including chains, sprockets, bearings, steering devices, etc. 3½ by 6 in.; pp. 90.

Hoisting Machines.

PATTEN MANUFACTURING CO., Chattanooga, Tenn.—Catalogue, pocket size, treating of building contractors' hoists. Illustrated. 4 by 6 in.; pp. 16.

Incandescent Units.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4561 treats of illumination and the best solutions of many of the problems involved. The bulletin is illustrated with many views of the Gem lamp and fixtures especially suited for its installation. Illumination tables giving the foot-candle values on different horizontal planes when the lamp is used with various types of Holophanes are also given. 8 by 10½ in.; pp. 16. Bulletin No. 4566 illustrates and describes G. E. Tantalum incandescent lamps. 8 by 10½ in.; pp. 12.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia—Pamphlet No. 64 illustrates and describes locomotives built for the Central Railroad of Brazil. 9 by 6 in.; pp. 32.

Locomotive Cranes.

BROWN HOISTING MACHINERY CO., Cleveland—Booklet containing an illustrated description of locomotive cranes with grab buckets for handling coal, ore, sand, ashes, etc., together with a partial list of users. 6 by 9 in.; pp. 40.

Pumping Machinery.

BUFFALO STEAM PUMP CO., Buffalo, N. Y.—Catalogue No. 187 illustrates and describes steam, power, centrifugal and turbine pumps for every service. Also contains tables giving speeds, capacities, etc. 6 by 9 in.; pp. 132.

Reinforced Concrete.

ABERTHAW CONSTRUCTION CO., 8 Beacon St., Boston—"Reinforced Concrete in Manufacturing Plants" is the title of catalogue No. 11 illustrating and describing not only a number of manufacturing plants built by this company, but also typical dams, bridges, chimneys, water towers and public buildings, as well as the Harvard Stadium.

Rock Drills.

C. T. CARNAHAN MFG. CO., Denver—Catalogue illustrating and describing air hammer rock drills and accessories. 7 by 10 in.; pp. 40.

Steam Specialties.

KITTS MANUFACTURING CO., Oswego, N. Y.—Well-printed catalogue illustrating and describing regulators, reducing valves, steam traps, safety water columns, pump governors, and low pressure boiler feeders. 6 by 8 in.; pp. 28.

OHIO BLOWER CO., Cleveland—Catalogue describing, in simple language, the Helico-Centrifugal principle which is applied in the design of the Swartout cast iron exhaust heads and steam and oil separators. Self-closing ventilators are also described and helpful tables given. pp. 80.

D. T. WILLIAMS VALVE CO., Cincinnati—Catalogue and price list illustrating and describing

brass and iron valves, gauge-cocks, fittings, oil and grease cups, lubricators, steam traps, separators, etc. Also contains much useful data. Fully indexed. 5 by 7 in.; pp. 180.

Steel Sheeting.

GEORGE W. JACKSON, INC., 169 W. Jackson Boulevard, Chicago—Catalogue illustrating, with a brief description, a few of the different uses to which interlocking steel sheeting can be adapted. Also contains numerous testimonial letters. 10 by 7 in.; pp. 70.

Steel Tires.

STANDARD STEEL WORKS, Harrison Bldg., Philadelphia—Booklet containing a reprint of a paper on the causes of defects and failures of steel tires read before the Western Railway Club by George L. Norris, M. E. Illustrated. 9 by 6 in.; pp. 38.

Ventilators.

E. B. BADGER & SONS CO., 40-55 Pitts St., Boston—Booklet illustrating and describing the Badger ventilator as a remedy for smoky chimneys and ill-ventilated rooms. 5 by 7½ in.; pp. 8.

Water Meters.

SIMPLEX VALVE & METER CO., 112 No. Broad St., Philadelphia—Catalogue devoted to an illustrated description of water meters for large pipes; controlling valves for stand pipes or reservoirs; rate controllers and loss of head gauges for filters; and automatic air valves. 6 by 9 in.; pp. 40.

Wire Rope.

HAZARD MFG. CO., Wilkes-Barre, Pa.—Catalogue illustrating and describing wire rope for general hoisting purposes, quarries, transmission of power, etc. 6 by 9 in.; pp. 96.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

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ENGINEERS: Leading employers everywhere seek through us experienced Civil, Electrical, Mechanical, Marine and Mining Engineers. List of positions open free if you state experience, salary and position desired. Offices in 12 cities. HAPGOODS, 305 Broadway, N. Y. 12-6

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"SUCCESS" AUTOMOBILE $250. The original motor-buggy. After eleven years labor by an engineer a perfect steel tired Auto. Runs 25 miles an hour, good hill climber. Write for particulars. SUCCESS AUTO-BUGGY MFG. CO., Inc., 522 De Baliviere Ave., St. Louis, Mo. 12-6

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THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guess-work; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

EVERY PRACTICAL ENGINEER should compile his own note book. Subscribe for Webber's tables, printed on 4x7" sheets, for insert binders. Every engineering subject, 25 cts. per sheet, printed on both sides. Write for information to WILLIAM O. WEBBER, Consulting Engineer, 432 Exchange Building, Boston, Mass. 9-5

THE ENGINEERING INDEX ANNUAL for 1906 embraces all branches of engineering, and clearly indexes alphabetically by subject about 7,000 important articles of permanent value which appeared during 1906 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 416 pages, 9½ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

MACHINERY DESIGNED

ORIGINAL MACHINERY designed by Mechanical Engineer with inventive ability, also improvements made for all practical purposes. Terms reasonable. Address Box 112, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-4

PATENT FOR SALE

WINDMILL GOVERNOR securing highest efficiency for windmills at *all velocities* of *wind*, increasing yearly output about 200%. Can be fitted to existing windmills. Address Box 111, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-4

IMPROVED MACHINERY

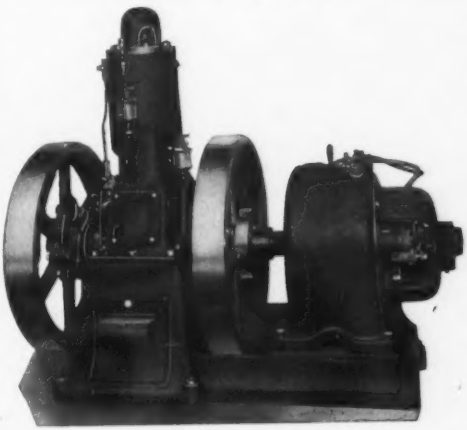
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

The Crescent Fuel Oil Engine.

IT is a well known fact that much money has been spent and a great deal of thought devoted to the development of an internal combustion engine that would successfully burn the cheaper and heavier oils. The increasing demand for gasoline for automobile and motor boat purposes has raised the price of this fuel practically beyond the reach of industrial power users.

The Crescent oil engine successfully burns as fuel either kerosene or fuel oil, and by this is meant that the old troubles of sooting up of engines, pistons sticking with carbon, and low efficiencies, all resulting from imperfect combustion, have been entirely eliminated in the Crescent. The fact also that the Crescent is a two-cycle engine, without valves, cam-shafts, gears or electric sparking devices, further commends it to the power users—due to the simplicity, reliability and the ease with which it is operated. The efficiencies realized in this engine are found to be higher when using fuel oil as fuel. In engines up to 12 horse power—10 horse-power hours are realized for every gallon burned; in engines from 20 to 30 horse power—11 horse-power hours; in engines 40 horse power and above—12 horse-power hours. These estimates are made of course when engine is running under full load conditions. It is obvious that this is a very high efficiency.



As the Crescent is a two cycle engine an impulse takes place at each revolution. This impulse is varied in intensity by the automatic action of the governor, which acts directly on the pump in such a way to deliver oil in rateable quantities into the combustion chamber. The governor control is so perfect in its action that a variation of not over 3 per cent. in the rate of rotation of the engine is shown between full load and no load. When the Crescent is used for electric lighting purposes no flicker or cycle beat is noticeable in the lights, and heavy fly wheels are not necessary to ensure a steady light or a smooth running machine.

Oil is carried in the base of the engine sufficient for ten hours' run. Should it become necessary, however, to have the oil supply tank buried under ground, the oil pumping device is so arranged as to pump the oil from this tank directly into the engine. In reference to meeting the exacting requirements of the Board of Underwriters, the

Crescent, through its design, complies with all their conditions. The gravity tank holding the fuel does not hold over one-half pint at any one time, and this the Board does not object to.

The simplicity of this engine is shown by the fact that the moving parts within the Crescent oil engine are a crank shaft, connecting rod, piston, and vaporizing nozzle; outside the engine is a governor, fly wheels, pump and pipe connections, and still, oils whose gravities vary from 26 to 45 degrees are successfully burned without any changes of mechanism.

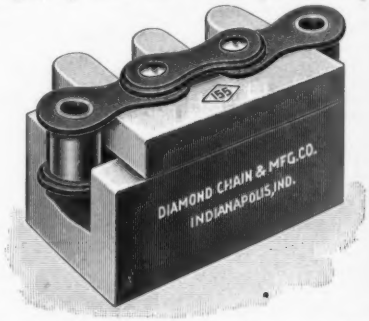
At present the engines are built in sizes ranging from 10 to 40 horse power, and are of single and double cylinder type. Larger engines are under way, and there is no reason to doubt but what engines built on this plan will shortly be made in sizes up to 500 horse power. The principle of burning the heavier oils has not yet been adapted to any other than the stationary engine, but the builders expect to be in the field soon with a line of marine engines adapted to the burning of fuel oil, and expect to realize the same economy as they do in the stationary engine.

Before closing this article it might be well to take into consideration the actual fuel cost of operating a 40 horse power engine ten hours. An engine of this size would get 12 horse-power hours from every gallon of fuel oil burned. A 40 horse-power engine running ten hours, would produce 400 horse-power hours. Getting 12 horse-power hours out of a gallon, the engine would consume in ten hours' run, 33 1-3 gallons of oil. With fuel oil at 4 cents per gallon (and it can be bought for this price almost anywhere), the fuel cost of operating a 40 horse-power engine ten hours, would be about $1.34. Should the fuel oil cost 5 cents per gallon, then the cost would be $1.67 for ten hours. Four hundred horse-power hours are practically equivalent to 300 K.W. hours. The cost of producing 300 K.W. hours would be the same as the cost of producing 400 horse-power hours. Then the fuel cost of producing 1 K. W. hour, using 4 cent oil, would be .44 cents, and using 5 cent oil, .56 cents. This is very cheap power, and is only made possible by the ability of the engine to burn the cheap oils perfectly.

The manufacturers, Samuel L. Moore & Sons' Corporation, Elizabethport, N. J., will be pleased to furnish any further information desired.

Repairing Roller Chain Drives.

ONE of the greatest advantages of roller chain drives over short belts is their freedom from expensive attention or repair troubles. An occasional oiling at long intervals will generally keep the chain in first-class running condition. Chains do not stretch like belts and consequently never have to be respliced or taken up. Nor is any surface dressing required, as the sprocket teeth engaging with the rollers prevent slip.



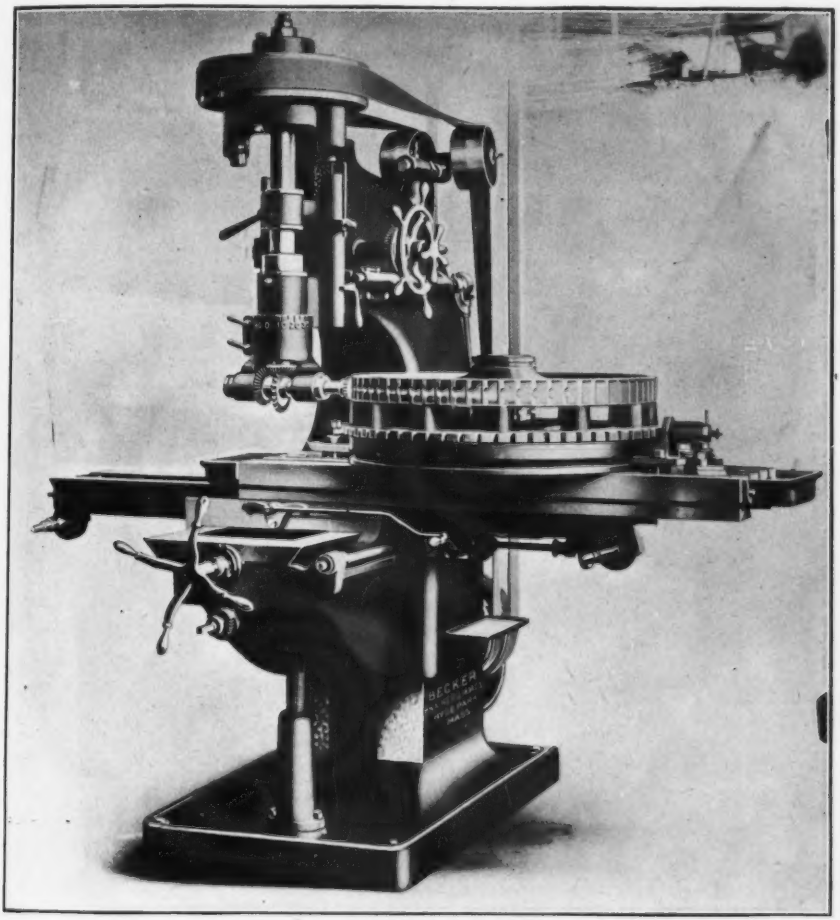
It occasionally happens, however, that a link may prove defective or be accidentally injured enough to make replacement desirable. For this purpose the Diamond repair block has just been put on the market, and promises to make riveted chain easier to repair than detachable chain. This tool is small enough to be carried in the pocket, and makes the insertion of a new link a very small matter. By placing the chain in the block, as shown, giving both rivet heads a light tap with the hammer and another with a center punch, the side bar may be lifted, the repair link inserted, and the chain drive back to work in less than ten minutes. If desirable to use the old link again, it is only necessary to put the link and side bar back into place and flatten out the two rivet ends with the hammer.

This speedy repair will be appreciated by those who have previously used belting on troublesome short drives. Chain goes into smaller space, does not let the machine stop when oil gets on the surface and with this repair block the link can be changed without even taking the chain off its sprockets, thus requiring but a fraction of the time required in hunting and applying trimming knife, clamps, cement, lacing or belt hooks.

The Diamond repair block is made by the Diamond Chain & Mfg. Co., of Indianapolis, Ind., who will gladly send descriptive literature upon request.

A Special Vertical Milling Machine.

THE adaptability of the vertical miller to special operations not already performed by any other type of machine is illustrated herewith. Here buckets were required to be cut in the circumference of the disc of a Sturtevant steam turbine. The difficulty of properly rigging up any other form of machine to do this work must be apparent. But the vertical milling machine presents a depth of throat, a range of movements, and a relation of spindle to platen provided by the horizontal attachment that renders the operations



comparatively simple. The machine was a No. 6, manufactured by the Becker-Brainard Milling Machine Co., Hyde Park, Mass., with standard dimensions as follows: Size of platen 49 inches by 18 inches; length of saddle 60 inches; longitudinal feed (automatic), 50 inches; cross feed with automatic stop, 20 inches, and vertical feed of spindle (automatic) of 13 inches. The greatest distance between spindle and platen is 30 inches, and between centre of spindle and neck is 24 inches.

The disc being operated was 26 inches in diameter, forged of open hearth steel. It was mounted upon and clamped to a circular slotted-edge jig plate which revolves freely about a pin projecting from a circular base plate which is securely clamped to the platen. The diameter of the pin is the same as that of the turbine shaft, the slots in the jig plate correspond in number and spacing to the buckets to be milled in the disc. A spring pawl or pin holds the ring in place as each bucket is milled. The value of relatively great distance between centre of the spindle and neck of the machine is evident.

In the horizontal attachment bevel gears transform the movement of the vertical spindle into that of the horizontal spindle. By means of the graduations this spindle may be set to operate at any angle in the horizontal plane. When properly set it may be securely clamped. The horizontal attachment which has been recently introduced by the Becker-Brainard Milling Machine Co. renders the vertical miller practically universal in its scope—far more so than a horizontal machine with vertical attachment. By its use worm and spur gears, spirals, hobs and racks may be cut. When so used the cutter is placed at the intersection of the centre lines of the vertical and horizontal spindles.

An Improved Under-Feed Stoker.

DURING the past few months the Taylor underfeed stoker has been installed in several of the large steam power plants in New York and vicinity. This underfeed stoker differs materially from earlier designs in combining the underfeed with the inclined gravity feed. This novel construction, in connection with several other features, has produced a stoker which is claimed to be free from the objections urged against other horizontal fuel bed stokers, such as caking, clinkering and irregular or smoke-producing combustion caused by the periodical opening of furnace doors whereby too much air is admitted. From a maintenance standpoint the new stoker must appeal to the operating engineer since no ignition, coking or combustion arches are required in it.

The device consists of an inclined grate made up of air-perforated tuyeres, which are simple cast-iron plates laid one on top of the other. Between the rows of tuyeres are two cylindrical rams, the upper ram receiving coal from a hopper and the lower ram feeding only the coal and partially consumed coke delivered from the upper ram. These two rams move in unison, the upper ram deriving its motion from a crank shaft on the front of the stoker and the lower ram from the connecting rod of the upper. The travel of the upper ram is fixed (about 10 ins.), that of the lower ram being adjustable to suit the conditions imposed by fuels of varying ash contents. In practice with ordinary fuels the lower ram travel is from 2 ins. to 3 ins.

The lower tuyeres rest on a rectangular box which acts as a support and also as an air box connecting all the tuyere rows to a common source of air supply. From this air box is hinged the sectional dump plate operated from the boiler front. This plate is unperforated, as combustion is supposed to be complete by the time sufficient ash has accumulated to require dumping. No arch combustion of any kind is used, but provision is made for introducing secondary air above the grate when needed at the higher rates of combustion.

The operation is as follows: Coal is fed between the several rows of tuyeres passing forward and upward and is met in its passage by streams of righly heated air projected horizontally. The tendency of the whole fuel bed from the

combined action of the rams is to move downward toward the dump, the resultant of the ram action and the fuel travel being to break up the fuel bed continuously.

This breaking action renders it unnecessary to slice or level the fuel bed, the coal distribution being even. The only attention necessary is the periodical dumping of the ash. In practice these dumps take place in from three to five hours according to the fuel consumption. The coal feed is regulated by driving the stoker mechanism from the engine or motor, which drives the forced blast fan. The relation of the air supply to the coal feed having once been established, all that is necessary is to change the speed of the fan engine in accordance with the demand for steam.

The claims of the manufacturer for this stoker are: Smokeless combustion throughout the entire range of operation, high furnace efficiency, maximum range of capacity, quick response to capacity demand and from a banked condition, no moving parts subjected to the fire, low operating cost, low maintenance cost and applicability to any externally fired boiler.

The builders have published several tables of trial data secured under conditions of operation in the New York plant, which show how this apparatus fills the claims of efficiency and capacity made for it.

The steam generator on which these tests were run is a standard water-tube boiler containing 6,386 sq. ft. of heating surface and a self-contained superheater of 760 sq. ft. of surface. There is no special furnace construction, the gravity underfeed stoker being inserted between the side walls directly under the boiler tubes.

The tests were conducted in accordance with the code of the American Society of Mechanical Engineers and all apparatus and instruments calibrated by comparison with standards. All tests, except one at maximum capacity were of eight hours duration and all results are averages of the entire period of each test.

The economical limit of capacity was not reached in these tests. A rate of combustion of 50 lbs. of coal per sq. ft. of grate surface, an evaporation of 8.1 lbs. of water per sq. ft. of heating surface or an equivalent boiler output of 1,500 h.p. is not at all beyond the range of economical operation.

This stoker is made by the Lenher Engineering Co., 39 Cortlandt street, New York.

Tests of Graphite on Ball Bearings.

THERE have from time to time appeared articles in the various trade papers condemning the use of graphite as a lubricant for ball bearings. The reason these articles have appeared, we presume, is because some users have had unpleasant experiences with inferior grades of graphite. Professor Goss has made some extensive tests with Dixon's Ticonderoga flake graphite as a lubricant for ball bearings combined with kerosene oil, lard oil and vaseline, and found that friction losses were very

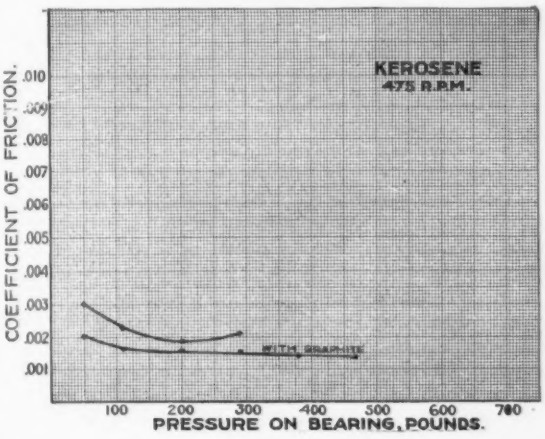


FIG. I.

much reduced and the bearings made to carry a heavier load when Dixon's Ticonderoga flake graphite was used. The following are extracts from Professor Goss' report:

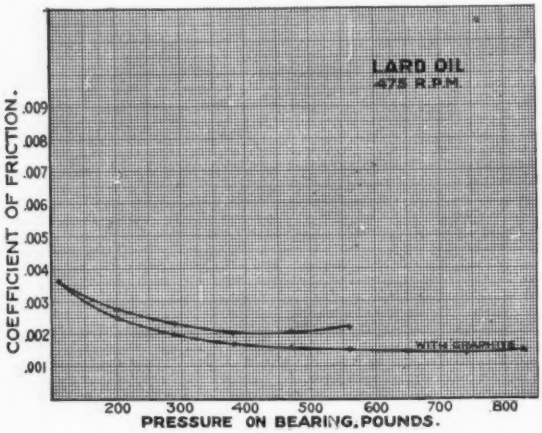


FIG. 2.

The test ball bearing has the form of a grooved ball-thrust bearing and was made by the Standard Roller Bearing Company of Philadelphia, Pa. It consists of two hardened steel rings, each having a groove or race to receive the balls. The bearing fits a 1 5/8-in. shaft and contains 23 7/16 in. balls. The lower race is caused to revolve through the action of the machine, while the upper one is fixed in position. The entire bearing is enclosed in a cup. The cup is held in place by a wire which serves to oppose its tendency to turn, and also to receive the tensional stresses due to the normal loading of the bearing.

The lower race rests upon a casting which is attached to the spindle of the machine. By means of pulleys the spindle may be driven at three different speeds. The pressure imposed upon the balls is regulated by means of weights applied to the lever arm, which is of such length that each ten pounds applied to the weight-pan gives a reaction of 90 pounds along the line of the spindle through the bearing, and thence to the test ball bearing. The bearing is similar in all respects to the test bearing, except that it is of greater capacity.

It has shown by previous experimentation that graphite can be efficiently applied as a lubricant when mixed in small quantities with oil or grease. Following this practice, six series of tests were run; the lubricant employed upon the test ball bearing being, respectively, kerosene, a mixture by weight of 96% kerosene and 4% graphite; lard oil, a mixture by weight of 96% lard oil and 4% graphite; vaseline, a mixture by weight of 96%

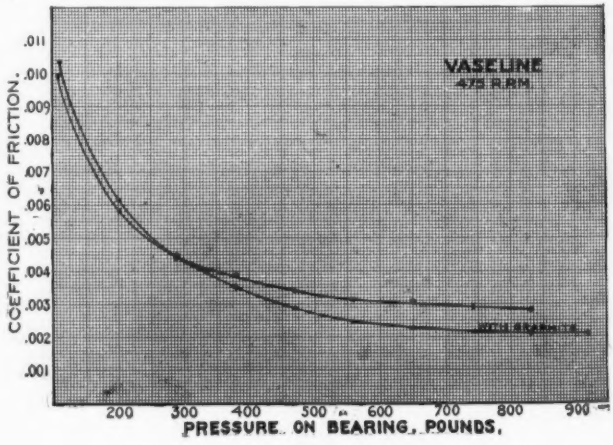


FIG. 3.

vaseline and 4% graphite; the graphite in all cases was Dixon's Ticonderoga flake graphite. Figs. 1, 2 and 3 show graphically the results obtained. Where the curves are not labeled, the results are without graphite.

As the results of these tests Professor Goss says in part that the following general conclusions may be drawn:

"A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard oil alone will do and which at the same time will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry.

"An oil as light as kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium heavy pressure.

"Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used.

"The admixture of graphite with either a liquid or a viscous lubricant serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry."

New York Subway Ventilation.

SHORTLY after the opening of the New York subway it was decided to ventilate the station toilets by some positive means. Small volume blowers were adopted, and sixty outfits were furnished by the American Blower Company. Later the Rapid Transit Commission (as it was then) decided upon a plan for ventilating the subway itself by means of centrifugal exhausters; and for this purpose, "ABC" steel plate exhaust fans were adopted, twenty-five of

which have been installed in special vaults built in the line of the subway, about midway between stations from Fulton to Fifty-ninth streets. These exhausters draw the air from the subway, many thousand cubic feet a minute, causing an equal amount of fresh air to flow in at the stations. This action is augmented by the plunger effect of the trains themselves forcing the air out through the fan vaults, by means of automatic louvers, which allow the air to pass out but close automatically when the air tends to flow in the opposite direction.

Independent of the ventilating equipment a cooling plant has been installed at the Brooklyn Bridge station of the subway, and there again four large "ABC" fans were employed. In the tunnel extending under the East River from the Battery to Brooklyn connecting the subways of Manhattan and Brooklyn fresh air is supplied by means of "ABC" blow-

ers, two of which are installed at each end of the tunnel, supplying air in the directions in which the trains operate.

Nor does this complete the application of the "ABC" apparatus to this class of work. Following closely upon their adoption by the Interborough Rapid Transit Company the engineers of the Hudson Companies decided upon "ABC" blowers for the ventilating of the McAdoo or Hudson tunnels connecting New York and Jersey City. This decision was immediately followed by the adoption by the architects of the McAdoo terminal building of "ABC" blowers for the ventilation of these large terminal buildings, which, taken together, will form the largest office building in the world.

Bascule Bridge.

THE tendency in railroad development during the last few years, both in the United States and abroad, has been the concentration of traffic on existing rights of way by means of multiple track construction, rather than through adjacent competing lines, extra trackage at the present time in the United States amounting to about 20 per cent. of the total mileage in this country. On many of our prominent railroads, particularly those through the more thickly populated districts, traffic has increased so rapidly during the past 10 years as to require two, four and six parallel tracks for its accommodation and economic handling. This increase in trackage will become common in a greater or lesser degree to every railroad as its territory is developed and the natural increase in traffic results. In the light of experience during the prosperous conditions of the past few years it would seem safe to predict that present railroad traffic will be doubled in the next 10 years and that this ratio of increase will continue for decades to come.

One of the most important features in the matter of handling a rapidly increasing traffic is the requirements for the accommodation of shipping at the crossing of navigable waterways. An inherent limitation of the center pier swing bridge for railroad traffic is the fact that it cannot be enlarged or widened to accommodate additional tracks. This necessitates its being discarded and removed at great loss both in the cost of the new bridge and the accompanying derangement of traffic. It is self evident that if a new swing bridge were constructed alongside of an existing swing bridge without a material increase in the right-of-way and a very wide spreading of tracks it would be impossible to operate either bridge because of interference. This difficulty is overcome by the modern type of bascule bridge which can be constructed as a single track structure and be enlarged to a double or multiple track bridge at any time without disturbing traffic or interfering with the existing bridge, by simply adding new bridges alongside of the structure then in use. These additional single or double track bridges can be operated as separate units or linked with the existing bridge and operated as one structure, as desired.

Among the bridges designed by the Scherzer Rolling Lift Bridge Company, Chicago, and now in operation or under construction both in this country and abroad, are many of the longest span and widest movable bridges ever constructed, nearly all of these structures having superseded and replaced center pier swing bridges in the movement for additional parallel tracks to accommodate increased traffic. Some of the more notable Scherzer rolling lift bridges are the four-track bridge for the Metropolitan West Side Elevated Railroad, Chicago; the double-track bridge for the Chicago Terminal Transfer Railroad at the entrance to the Grand Central Station, Chicago; the eight-track bridge at Chicago used by the Pennsylvania Lines, Chicago Terminal Transfer, Chicago Junction and Baltimore & Ohio Railroads; the single-track bridge for the Big Four Route at Cleveland; the double track bridge used by the Big Four, Lake Shore & Michigan Southern and Erie Railroads at Cleveland, the duplicate adjacent double-track bridges used by the Newburgh

& South Shore and Baltimore & Ohio Railroad Companies at Cleveland; the very long span single-track bridge for the Baltimore & Ohio Railroad at Cleveland; a double-track bridge at Cleveland for the New York, Chicago & St. Louis Railroad; two bridges used by the Central Railroad of New Jersey, the Reading and the Baltimore & Ohio Railroads across Newark Bay; a double-track bridge for the Boston, Revere Beach & Lynn Railroad near Breton and the six-track bridge at the entrance to the South Terminal Station. Boston, for the New York, New Haven & Hartford Railroad. The New Haven Railroad also has Scherzer rolling lift bridges in service at Neponset, Massachusetts; Bridgeport; Coscob and Westport, Connecticut; and across the Housatonic, Niantic and Connecticut Rivers, Connecticut. A number of additional bridges of the Scherzer type are under construction for the New Haven Road at different important crossings, among them being a double track bridge across the Seekonk River at Providence and six-track bridges across the Bronx River and Eastchester Bay on the Harlem River branch of their New York division. The New York Central lines have under construction a double-track Scherzer rolling lift bridge across Wappinger Creek on the Eastern Division. This bridge is expected to be placed in service in the near future. Double-track Scherzer rolling lift bridges for the Lake Shore & Michigan Southern and Chicago, Lake Shore & Eastern Railways at Indiana Harbor are under construction and will be ready for service upon the opening of the East Chicago Canal, which they cross. The Norfolk & Western Railway has two double-track Scherzer rolling lift bridges under construction across the Southern and Eastern Branches of the Elizabeth River near Norfolk, and a single-track bridge is under construction for the Seaboard air line across Hillsboro Bay, Tampa, as a part of the new terminal improvements being made by the Seaboard air line at that point. Two single-track bridges of the Scherzer type are under construction for the Norfolk & Southern Railway across Albemarle sound. as the movable spans in along trestle the Norfolk & Southern Road has under construction to replace the present ferry service between Edonton and Mackay's Ferry. The double-track Scherzer rolling lift bridge crossing Coney Island creek for the Brooklyn Rapid Transit System has been in service for several months carrying the heavy traffic on that line. The erection of the single-track Scherzer rolling lift bridge crossing Rainy river for the Duluth, Rainy Lake & Winnipeg and Canadian Northern Railroads is now being carried on, and it is expected to place the bridge in service within thirty days. Work is also being pushed on the long span double-track bridge for the San Pedro, Los Angeles & Salt Lake Railroad now under construction across the San Gabriel river at Long Beach, California.

Several bridges of the Scherzer type designed for foreign railroad service are now in active use, among them being a double-track bridge for the South Eastern & Chatham Railway across the Swale river, England; a double-track bridge for the Fishguard & Rosslare Railways & Harbours Company across the Suir river, Ireland, and three single-track bridges for the Dutch Railroad Company, Holland. A number of Scherzer rolling lift bridges are also under construction for both British and Colonial railway service. It is expected that the combination single-track railway and highway bridge at Barrow-in-Furness, England, and the two double-track bridges for the Buenos Ayres Great Southern Railway at Buenos Ayres, Argentina, will soon be placed in service, and work is now being pushed on the long open span bridge for the Burma railways near Rangoon, India. Several bridges of the Scherzer type are in operation or under construction in Egypt and the two railroad and highway bridges for the Tehuantepec Railway Company at Salina Cruz, Mexico, will be completed in the near future.

About fifty Scherzer rolling lift bridges have already been constructed for the use of electric street railway and

inter-urban service, these bridges having nearly all been constructed as double and multiple track structures.

Forced Draft for Boilers.

NATURAL draft sufficient to get even fair returns from the fuel consumed by the draft means tall and expensive chimneys, and if the business grows so that more power is needed the chimney can not be enlarged, and a new one must be built. Natural draft for boilers is somewhat similar to natural draft for ventilation. The practice until quite recently has been to build flues or ducts for creating drafts, and to accelerate the draft heat was applied by means of fire, steam coils, jets of gas, etc. Extensive tests, however, have shown that with a disc or centrifugal fan many times as much air can be moved with steam, gas or electricity, as can be moved by using the same amount of heat units applied directly to accelerate draft in a flue or duct in a given size.

In the question of draft for boilers similar conditions arise. Most of the boiler plants in this country are run by the natural draft of tall chimneys, and it is a question if more economical results cannot be obtained in every instance by the use of fans of proper construction and specially adapted for the work. There are three principal systems in use, the steam jet blower system, the fan driven by engine or electric motor forcing air under the grate, and the use of fans on the plan of induced draft.

There are objections peculiar to each one of these systems: the steam jet blower is said to take too much steam, and it is claimed that the fan for forcing air under the grates takes up valuable room and is quite excessive in cost of installation.

The English are now using a good many fans of the type known as Sirocco, which they claim are smaller, occupy less space, and give better results than the regular centrifugal fan. Centrifugal fans, driven by direct attached turbine engines, to be used either for forced or induced draft, have been used on account of the high speed at which a small fan can be run, and by allowing the steam from the exhaust of the engine to go through a separate pipe under the grate much better results are often secured, as well as a saving in fuel.

Another fan and turbine-engine combination of a still more compact and simpler construction is adapted for the centrifugal cone or disc types, so that it can be used for various purposes. For forced draft this fan is placed inside of a short drum or pipe that can be placed in the side or rear wall of the boiler. This fan has a series of cups or buckets

placed on it in a simple manner in such form that the fan and turbine engine are practically one complete machine, running on ball bearings, and driven by one or two small steam jets similar to the regular turbine steam engine or turbine water wheel. The steam jets force the fan up to a high speed, moving a large volume of air and at the same time carrying along the steam with it, thus thoroughly mixing the air and steam and allowing it to go under the grate dry and at a good heat. Each boiler has its own fan. A pipe is carried from the fan to the top of the boiler or any other place where hot air can be obtained, thus saving heat units and at the same time ventilating and cooling the place from which the air is taken. Such a fan is inexpensive to install, takes little space, effects

a saving in fuel, increases the capacity of the boiler, requires little steam to operate and uses this steam to aid combustion, avoiding clinkers and reducing repairs. Fans or blowers of this type are manufactured and installed by the L. J. Wing Manufacturing Co., 90 West St., New York City.

By having the damper partially closed and controlled by a regulator that also controls the speed of the fan, an equal pressure of air is maintained beneath the grate and the plenum above, which will give all parts of the tubes the full benefit of the combustion gases and hold the pressure of the boiler within one or two points of the pressure for which the regulator is set.

Hele-Shaw Clutch.

MERCHANT & EVANS CO., Philadelphia, are manufacturing the Hele-Shaw clutch, which has secured its greatest popularity for use in automobile construction, but which has been very extensively and successfully employed in a wide range of mechanical drives of every description abroad. The English manufacturers, from whom Merchant & Evans Co. secured the exclusive license for the manufacture of this clutch, under the American patents, have installed something like 25,000 H.P. in the past four years in England and Europe and foreign countries in over 50 different applications ranging from 1 to 1,000 H.P. This device has the combined qualities of efficiency, smoothness of action and endurance, with great compactness and comparatively small size—thus making it peculiarly suited for very heavy duty in very small space.

The peculiarity and the merit of the clutch lie in the fact that the engagement of the plates is in a 53 degree V-shaped circumferential groove. Although a trifling mechanical change to the casual thinker it constitutes the whole difference between success and failure in a metallic disc clutch. By virtue of engaging a V groove of one-third of a plane surface each pair of plates does three times the work of any flat pair, or the same work with one-third the spring pressure. It is obvious, therefore, that at the same engaging spring pressure the Hele-Shaw clutch will do three times the work of any other metallic disc clutch of a similar design, or in a restricted space the Hele-Shaw clutch one-third the size of any similar clutch, will do this work equally well. By virtue of the engagement in a V-shaped groove the flat portions of the plates or fins, as they are called, are always separated by about 1/3 in. This permits the circulation of an oil bath constantly right up to the point of work and radiates heat continuously, thus preventing the Hele-Shaw clutch from ever heating due to slippage, whereas flat plates in engaging constitute a solid pack of metal normally and will so heat as to carbonize or blacken the oil. In the event of the accidental absence of oil the same amount of heat that would distort a flat plate does no injury to the Hele-Shaw plate because of its transverse rigidity due to its peculiar groove. It therefore cannot be injured by heat. This makes it peculiarly advantageous for constant duty, work such as planer and machine tool reverse gears, automobile and motor boat work, all automobile drives, where the clutch is constantly working in and out of engagement, pulley and coupling work at important points, cranes, gas engine and electric motor drives, rope drive work for conveyors, hoists, etc.

A peculiarity of this clutch which puts it in a class apart from any other one is its uniform rate of pick-up. When thrown into engagement it picks up its load on a straight diagrammatic line instead of a curved one. This peculiarly gratifying property of the Hele-Shaw clutch appeared in its experimental tryouts and was later proven in practice by its employment to couple up alternating, constant speed, electric motors to web printing presses. Unless the rate of pick-up in this engagement is absolutely uniform from a state of rest to full speed the damp paper in the press is torn.

News Supplement

The Engineering Magazine—May, 1908

Personal.

—Robert A. Cummings, M. Am. Soc. C. E., has moved his offices from 4 Smithfield St. to 316 Fourth Ave., Pittsburg, Pa.

—J. E. Evans, for the past 20 years the Chicago representative of The S. Obermayer Co., was elected alderman at the last election held in that city.

—E. E. Keller, for over 20 years connected with the Westinghouse interests and for 14 years vice-president of The Westinghouse Machine Co., having completed his duties as receiver and general manager, severed his connection with the management of that company on the first of this month.

Industrial Notes.

—The Electric Welding Co. has moved its offices from 4 Smithfield St. to 316 Fourth Ave., Pittsburg, Pa.

—The Lehigh Valley Testing Laboratory have removed their offices from 4 Smithfield St. to 316 Fourth Ave., Pittsburg, Pa.

—The New York office of H. W. Caldwell & Son Co. is now located at the Fulton Building, Hudson Terminal, 50 Church Street.

—The New York offices of Crocker-Wheeler Co. are now located at 32 Cortlandt Street in the Cortland Building, Hudson Terminal.

—Keystone Driller Co., Beaver Falls, Pa., have purchased the deep well pump business of the Downie Pump Co., Downieville, Pa.

—The summer meeting of The American Society of Heating and Ventilating Engineers will be held at Niagara Falls, July 24th and 25th.

—Turner Construction Co., 11 Broadway, New York, in Bulletin No. 3 illustrate a number of reinforced concrete factories and warehouses erected by them.

—The Triumph Ice Machine Co., Cincinnati, announces the opening of a branch office in Atlanta, Ga., at 220 Randolph Bldg., with Milton W. Arrowood in charge.

—The Wheeler Condenser Engineering Co., Carteret, N. J., has made arrangements with Charles S. Lewis & Co., Granite Bldg., St. Louis, to handle Wheeler apparatus in the state of Missouri.

—The main office and factory of the T. R. Almond Mfg. Co. has been removed to Ashburnham, Mass. The New York office will be located at 40 Murray Street, where they will carry a well assorted stock.

—Tucker & Vinton, Terminal Building, 41st St. and Park Ave., New York, have issued, in booklet form, reproductions from photographs of representative concrete structures erected by them in the past ten years.

—Wm. B. Scaife & Sons Co., Pittsburg, have issued a pamphlet entitled "Water for Economical Steam Generation" by J. C. Wm. Greth. The matter in the pamphlet originally appeared in The Engineering Magazine for February and March, 1908.

—Atlas Portland Cement Co., 30 Broad St., New York, are issuing a booklet containing a partial reproduction of the prize designs submitted for the "Concrete House Competition" of the Association of American Portland Cement Manufacturers of Philadelphia.

—"At Work Around the World" is the title of a well-printed and handsomely illustrated book issued by J. G. White & Co., Inc., 41-43 Wall St., New York, describing some of the work done by this Company and its associated organizations on five continents.

—The Westinghouse Electric & Manufacturing Co. through its export department has received a contract from the Dominion Iron and Steel Co., Halifax, N. S., for a 500 H.P. electric generator, which will be used in the operation of one of the company's iron mines on Belle Island, Newfoundland.

—Through an oversight the name of the manufacturers of the Lawrence Balance Dynamometer illustrated and described on page 41 of our Improved Machinery Department for April was omitted. Inquiries about this device should be addressed to the Lawrence Machine Co., Lawrence, Mass.

—To what extent electric mining machinery has been introduced from America into Mexico and has aided in a practical revolution of the entire mining industry of that country may be estimated from the fact that in one of the mining camps at Guanajuata, the Pinginco mines, no less than 250 Westinghouse electric motors are being operated ranging in capacity from 5 to 200 H.P.

—Among recent orders taken by The Ohio Blower Co., Cleveland, for their gravity closing ventilators, is one from the Richardson Paper Co., Lockland, Ohio, for a total of 39 ventilators. Twenty-six of these are 24 inches diameter for ventilating the machine room, six are 36 inches diameter for ventilating the beater room, and seven of the same size are to be used for the ventilation of the new power house. All are to be supplied with dampers.

—The S. Obermayer Co. has opened a warehouse at 1604 North Broadway, St. Louis. C. M. Barker is in charge. They now have factories and warehouses located as follows: Cincinnati, 647 Evans St.; Chicago, 18th and Rockwell Sts.; Pittsburg, 35th and Charlotte Sts.; Philadelphia, 2514 Aspen St.; St. Louis, 1604 North Broadway; Cleveland, 6305 Euclid Ave.; Denver, 305 Appel Bldg. and 620 19th St.; Kansas City, Massachusetts Bldg.; Milwaukee, 696 Prospect Ave.; Troy Campbell's Highway and Thomas St.

—Among recent orders for heating and ventilating apparatus for large buildings placed with the Massachusetts Fan Co., Watertown, Mass., are those for one double 110 inch fan with heater for the Methodist Church, Wilkinsburg, Pa.; one 120 inch fan with heating coils and Davidson exhaust fan for the Finney Chapel, Oberlin, Ohio; and one 180 inch and one 60 inch engine driven fan for the Y. M. C. A. Building, St. Paul, Minn. Also a complete heating and ventilating apparatus for the Tuberculosis Hospital connected with the Minnesota State Hospital, St. Peter, Minn.

—The Westinghouse Air Brake Co. has within the last three years completed the development of an entirely new type of brake for freight, passenger and locomotive service which has proved so successful that many of the larger railroads have already adopted it and made it standard in all their rolling stock. The system represents the brake requirements of modern railroading in its highest form, its demand being necessitated by the longer freight trains now in use and also by the higher speeds and greater weight of the modern passenger train, where safety, combined with economical operation, are absolutely essential. This new brake can stop a freight train of one hundred cars as quickly as the old form of brake would stop a fifty car train.

—L. J. Wing Mfg. Co., West Street Building, New York, report among recent sales of turbine blowers and ventilating fans the following: Hall & Johns, Gloversville, N. Y.; Tolhurst Machine Wks., Troy, N. Y.; Mason Perkins Paper Co., Bristol, N. H.; J. H. & C. K. Eagle, Shamokin, Pa.; Russell Burdsall & Ward, Port Chester, N. Y.; Rubsam & Horrmann, Stapleton, S. I.; G. Siegle & Co., Rosebank, S. I.; Geo. D. Whitcomb Co., Birmingham, Ala.; American Can Co., New York; Hotel Strand, Atlantic City, N. J.; Alfred J. Cammeyer, New York; A. C. Harris Co., New York; N. J. & Pennsylvania Traction Co., Trenton; Standard Chain Co., Columbus, Ohio; Bloomingdale Bros., New York; Union Ice Co., Newark; Biddle Purchasing Co., New York; Howe Company, Louisville, Ky.; Lehn & Fink Wks., Brooklyn; Charles Gulden, New York.

—*General Electric Review* for April contains the following articles: Gas Power, by H. H. Suplee; Currency and Finance, Part II, by Henry W. Darling; The Electric Motor in the Silk Industry, by Andrew Kidd, Jr.; Geology of Jamaica, by Rossiter W. Raymond; Rotary Converters, Part IV, by Ernst J. Berg; Store Lighting with Enclosed Arc Lamps, by G. H. Stickney; Electric Motors and Their Application, by C. F. Lawrence; Influence of Wave Form of E.M.F. on Core Loss and Exciting Cur-

rent in Transformers, by L. T. Robinson and A. Holz; The Tantalum Lamp, the Salvation of Overloaded Systems, by Oliver F. Brastow; Polyphase Maximum Watt Demand Indicator, Type W, by W. F. Howe; Three Phase to Two Phase Transformation, with Special Reference to Core Type Transformers, by W. J. Wooldridge; and Electrically Equipped Hospital Laundries, by W. H. Rue. Published by the General Electric Company's Publication Bureau, Schenectady, N. Y.

—The Bristol Company of Waterbury, Conn., has come under the control of Prof. William H. Bristol whose inventions this company has been manufacturing since it was first organized in 1889. Prof. Bristol assumed active charge of the management of the business on March 28th, and now owns the majority interest. The business which has been carried on under the personal name of Prof. Bristol at New York will hereafter be combined with the Bristol Company, and by this consolidation of interests the Bristol Company will now have the most complete line of recording instruments in the world for pressure, temperature, electricity, and for a great variety of other applications.

The Bristol Company was organized in 1889 under the name of Bristol's Manufacturing Company to manufacture Bristol's pressure gauges and Bristol's steel belt lacing, for which William H. Bristol had taken out patents. To these were added many other inventions from time to time and in 1894 the business was incorporated under the name of The Bristol Company. Two years ago Prof. Bristol withdrew from the presidency of the company, and since that time has developed many new inventions, including the Wm. H. Bristol electric pyrometers and patented smoked chart recorders. The new pyrometers have come into wide use, there being, for instance, fifty of these pyrometers in service in one of the large steel plants. Prof. Bristol has taken out a large number of patents on new instruments during the last three years. One of these which will be soon put on the market is the long distance electric thermometer, designed especially for indicating and recording refrigeration, atmospheric and drying temperatures. This instrument will fill a long-felt want for use where it is desired to quickly indicate at some central station by means of switches the temperatures at several distant points.

The new lines of Wm. H. Bristol instruments supplement those of The Bristol Company, supplying a variety for applications for which the old instruments could not be recommended. For example, the standard Bristol's recording thermometers cannot be successfully used for temperatures above 600° F., while the Wm. H. Bristol pyrometers are being applied to great advantage for the higher ranges of temperature, especially for ranges from 600° to 2,600° F. The new lines of Wm. H. Bristol pyrometers are fitted with special movements made by the Weston Electrical Instrument Company, and are designed for extremely accurate measurements. The combined line of recording instruments to be hereafter manufactured by the Bristol Company will make it impossible for the company to co-operate better than ever before with its customers in giving them perfectly satisfactory service.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

Corrugated Bars.

EXPANDED METAL AND CORRUGATED BAR CO., Frisco Bldg., St. Louis—Well-printed catalogue describing corrugated bars for reinforced concrete construction and is illustrated with views of many buildings in which these bars were used. Also contains tables for use in designing reinforced concrete beams. 10 by 8 in.; pp. 112.

Dredges.

ATLANTIC EQUIPMENT CO., 111 Broadway, New York—Pamphlet No. 10,028 treats of dredging machines of standard types for every service. Illustrated. 9 by 6 in.; pp. 48. Pamphlet No. 10,014 is devoted to numerous testimonial letters from users of their steam shovels. 9 by 6 in.; pp. 32.

Dynamometers.

LAWRENCE MACHINE CO., Lawrence, Mass.—Bulletin No. 16 illustrates and describes balance dynamometer for weighing transmitted power. 6 by 9 in.; pp. 4.

Electrical Equipment.

CROCKER-WHEELER CO., Ampere, N. J.—Bulletins Nos. 95, 97, 98, 99 and 100 illustrating and describing respectively alternating current generators; direct current switchboard panels; direct current motors; motors installed in the Bethlehem Rail and Structural Mills; and belt type, direct current motors.

Fans.

ROBBINS & MYERS CO., Springfield, Ohio—Catalogue devoted to an illustrated description of ceiling, desk, bracket, oscillating desk and exhaust fans for direct and alternating current circuits. 8 by 10 in.; pp. 36.

Furnaces.

HAWLEY DOWN DRAFT FURNACE CO., Superior and Townsend Streets, Chicago—Well-printed catalogue illustrating and describing the Schwartz metal melting and refining furnaces using crude oil, fuel oil or gas for fuel. Also contains tables giving the results of tests. 8 by 10 in.; pp. 80.

Hammer Drills.

SULLIVAN MACHINERY CO., Railway Exchange, Chicago—Bulletin No. 60-A is devoted to an illustrated description of hammer drills for running work that can be operated by one man. 6 by 9 in.; pp. 12.

Heaters.

ROCKWELL ENGINEERING CO., 26 Cortlandt St., New York—Leaflet illustrating and describing portable heaters for oil fuel. 6 by 9 in.; pp. 4.

High Pressure Vacuum Apparatus.

ALBERGER CONDENSER CO., 95 Liberty St., New York—Catalogue No. 8 illustrates and describes high vacuum apparatus especially adapted to vacuum pans, multiple effects, evaporators and stills. 6 by 9 in.; pp. 32.

Lathes.

MIAMI VALLEY MACHINE TOOL CO., Dayton, Ohio—Catalogue illustrating and briefly describing lathes. Sensitive drills are also treated. Also contains tables giving principal dimensions and a list giving few users. 6 by 3½ in.; pp. 12.

UNITED ENGINEERING & FOUNDRY CO., Pittsburgh—Catalogue devoted to an illustrated description of roll turning lathes. 10 by 8¼ in.; pp. 20. Also a catalogue treating of high speed saws for iron and steel works. 10 by 8½ in.; pp. 22. Both catalogues are well printed and give a partial list of users of each tool.

Lightning Arresters.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4573 illustrates and describes the graded shunt resistance multigap lightning arresters. Also contains detailed descriptions of low voltage arresters, static dischargers, constant-current horn arresters, disconnecting switches, choke coils and type M, form D-2 direct-current arrester for voltages up to 6000. Tables of general data regarding the apparatus, connection and dimension diagrams, etc., are also included. 8 by 10½ in.; pp. 32.

Oiling Devices.

WM. W. NUGENT & CO., 18 West Randolph St., Chicago—Catalogue describing, with prices, a full line of oiling and lubricating devices. Illustrated. 6 by 9 in.; pp. 96.

Portable Drilling Machines.

STAR DRILLING MACHINE CO., Akron, Ohio—Folder giving facts and figures about Star portable drilling machines in operation on the Panama Canal. 3½ by 6 in.; pp. 4.

Power Hammers.

BEAUDRY & CO., 141 Milk St., Boston.—Booklet illustrating and describing power hammers in sizes from 50 to 500 lbs. weight of ram, and are adapted to almost every kind of forging. 3½ by 6¼ in.; pp. 12.

Pumping Machinery.

ERIE PUMP & ENGINE CO., Erie, Pa.—Catalogue F illustrates and describes centrifugal pumping machinery, together with tables giving specifications, prices, etc. Gas, gasoline and steam engines for marine or stationary purposes, are also given a place. 6 by 9 in.; pp. 36.

Steam Specialties.

JOHN DAVIS CO., Chicago—Catalogue 5 illustrates and describes regulating and back pressure valves, steam traps, separators, indicators, etc., also contains tables giving dimensions and prices. 6 by 9 in.; pp. 40.

WRIGHT MANUFACTURING CO., 70 Woodbridge St., Detroit.—Catalogue No. 11 is devoted to an illustrated description of high- and low-pressure steam traps, water columns, exhaust heads, filters, air traps, and oil and water separating tanks, together with prices and sizes. 6 by 9 in.; pp. 44.

Traveling Cranes.

CLEVELAND CRANE & CAR CO., Wickliffe, Ohio—Catalogue describing electric traveling cranes from 1 to 100 tons for all purposes and illustrated with views of actual installations. 12 by 9 in.; pp. 50.

Water Softener.

NORTHERN WATER SOFTENER CO., Madison, Wis.—Catalogue containing a well illustrated description of the Bartlett water softener. This softener is of the continuous type and is automatic in its operation. 9 by 12 in.; pp. 20.

DODGE MANUFACTURING CO., Mishawaka, Ind.—Catalogue illustrating and describing the Eureka water softening and purifying apparatus for steam plants and industrial purposes. The catalogue is well printed and contains numerous testimonial letters. 9 by 12 in.; pp. 48.

Water-Wheel Governors.

STURGESS ENGINEERING DEPT., THE LUDLOW VALVE MFG. CO., Troy, N. Y.—Well-printed catalogue illustrating and describing water-wheel governors, together with views of plants and testimonial letters. Relief valves and air compressors are also treated. 7¾ by 10 in.; pp. 62.

Wire Fences.

ANCHOR POST IRON WORKS, 147 Nassau St., New York—Catalogue illustrating and describing unclimable wire fences, for all purposes, but especially for use in factories and industrial plants. 8 by 5½ in.; pp. 16.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

HELP WANTED

CHEMISTS: Desirable openings for experienced chemists; various locations; salaries, $1000-$3000. Also positions for Architects, Draftsmen, Foremen, Superintendents, Engineers, Inspectors and Technical Specialists of all kinds. Offices in 12 cities. HAPGOODS, 305 Broadway, New York. 12-6

SITUATIONS WANTED

A SITUATION as Works Manager or General Superintendent by a high grade executive and mechanic. What is desired is a situation with some company where the production is not satisfactory, either quantity or quality; where the systems in use are not giving the desired results; where piece work or premium systems have been too costly or have proved a failure; or where manual labor has or is the cause of trouble through lack of discipline or lack of interest due to misunderstanding. Will undertake the reorganization of an old plant or the installation of new. The class of business desired is the manufacture of medium or heavy mechanical goods or machinery of any value. The salary to be the minimum until ability and worth have been proven, but success must be rewarded by admittance to the company, a membership in the board of directors or increased salary. My present location is Massachusetts, but I am willing to change. American birth, 38 years of age, temperate, of good health, habits and character. Can give any class of references required. At present employed, but can retire from present situation at any time. Address Box 116, care THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-5

EXECUTIVE POSITION by man with eighteen years' business experience. Manufacturing cost accounting, factory management, systematizing. Proven executive ability. Age 32. Now engaged in responsible position large eastern manufactory. Address Box 114, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-5

ACCOMPLISHED ACCOUNTANT with twenty years' practical factory and general experience, at present responsible for interests capitalized at over a million dollars, desires position as confidential executive to man of affairs, where integrity and ability coupled with sound common sense and discretion will be suitably appraised. Earning power of industrial plants and real estate developed. Cost accounting. Audits and investigations. Technical correspondence. Good manager, inventive and resourceful. References exchanged. Box 115, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-5

AUTOMOBILES

"SUCCESS" AUTOMOBILE $250. The original motor-buggy. After eleven years labor by an engineer a perfect steel tired Auto. Runs 25 miles an hour, good hill climber. Write for particulars. SUCCESS AUTO-BUGGY MFG. CO., Inc., 522 De Baliviere Ave., St. Louis, Mo. 12-6

BOOKS

THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guess-work; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

EVERY PRACTICAL ENGINEER should compile his own note book. Subscribe for Webber's tables, printed on 4x7" sheets, for insert binders. Every engineering subject, 25 cts. per sheet, printed on both sides. Write for information to WILLIAM O. WEBBER, Consulting Engineer, 432 Exchange Building, Boston, Mass. 9-5

THE ENGINEERING INDEX ANNUAL for 1907 embraces all branches of engineering, and clearly indexes alphabetically by subject about 9,000 important articles of permanent value which appeared during 1907 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 450 pages, 9½ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PATENTS FOR SALE

WINDMILL GOVERNOR—securing highest efficiency for windmills at all velocities of wind. Steam Turbine—to be experimented with. Penholder—a new article of manufacture. Address Box 113, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-5

IMPROVED MACHINERY

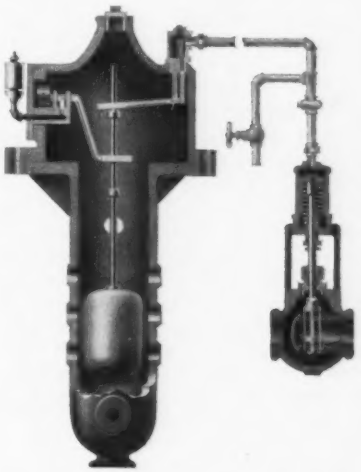
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Gould Feed-Water Regulator.

THE Gould feed-water regulator guarantees maximum boiler efficiency, furnishes a continuous feed in exact proportion to evaporation, and eliminates all possibility of dangerous accidents resulting from an improper water level, assures dryer steam, reduces fuel bills, and extends a beneficial influence throughout the entire plant. If water enters the boiler faster than it is being evaporated, the supply is automatically reduced, or entirely shut off. If the rate of evaporation increases more water is automatically let in to make good the deficiency, and by adjusting the bleed valve you can place and keep the level wherever you like. It is simple in design, positive in operation, has few parts and is the only regulator whose alarm valve and operating valve in column can be removed and replaced without disconnecting the upper part of the water column.

It will be noticed from the illustration that this regulator consists of a specially designed water column, and connected thereto by ⅜ inch steam pressure line a controlling valve which is placed in the individual feed line to the boiler. It is obvious that by adjustment of collars on float rod, water may be carried at any desired point and when so adjusted the water level will be constantly maintained with but the slightest of variation. If water should from any cause rise in the boiler, the upper collar on float rod immediately contacts lever of operating valve, partially or entirely closing controlling valve as occasion requires. When water recedes in the boiler, the float lowers, the operating valve in the column closes, and the steam in the pressure line connecting controlling valve is gradually dissipated through the regulating bleed valve. Any condensation forming in the pressure line on the piston is relieved through the drip in the bottom of the piston. The regulating bleed valve is left slightly open at all times and can be adjusted to control



fully the amount of pressure desired on top of piston. This bleed valve referred to is provided for the more even regulation of the apparatus and by adjusting the opening of this valve which is of a form capable of close adjustment to suit the requirements of service, the regulator may be set to maintain a higher or lower water level or to preserve the same level under different

conditions of steam and water pressure. The travel of the piston of the controlling valve permits of a maximum valve opening of three quarters of an inch, which insures a rapid delivery of water to the boiler required when demand is excessive.

The valve in the water end of the controlling valve is of a balanced slide-valve type and is normally held open by a spring inside of the piston. When the valve is closed no amount of back pressure in the water feed line can force the valve open at an inopportune time by overcoming the steam pressure on top of the piston, as pressure is equally distributed upon the upper and lower discs; consequently there is no possibility of flooding the boilers. This protection is not secured with single seated automatic valves. The water column is provided with a high and low water alarm so constructed that it can be removed and replaced in a few moments without the necessity of disconnecting the upper part of the column. In fact, all parts of the water column with the exception of the float can be removed in this manner; it is also convenient to adjust collars on the float rod through the opening in the side when the alarm parts are removed by removing the plug in the top of the column and allowing the float to move upwards. If the high water alarm is not desired, the lower collar on the float rod can be either lowered or removed entirely; when so arranged the column will alarm for low water only.

This feed-water regulator is made by the Safety Equipment Manufacturing Co., Chicago, Ill.

An Interesting Talk on Concrete.

AT the invitation of the Concrete Association of America the regular meeting of the New York Chapter of the American Institute of Architects was held in the permanent exhibition room of the Concrete Association of America in the Brunswick Building, New York City, on Wednesday evening, May 13th, last.

The speakers were President R. F. Tucker, of the Concrete Association, who made some introductory remarks; H. C. Turner, president of the Turner Construction Co.; F. G. Webber, Merrill Watson, and Mr. Norris, of Boston.

Mr. Turner presented about forty-five lantern slides illustrating representative reinforced concrete work as constructed in New York during the past six or seven years. The pictures showed concrete construction of all characters, including sand bins, railroad fences, subway stairs, cow barns, farm buildings, reservoirs, factories, warehouses, mills, office buildings, loft buildings and model factories, such as those of the Bush Terminal Company in South Brooklyn.

In commenting upon the pictures the first points brought out by Mr. Turner were the absolute fireproofness of reinforced concrete, the economy of this method of construction over any other fireproof construction, and the economy when compared to mill construction, provided that consideration is given the annual fixed charges, such as insurance, depreciation, elimination of vibration, availability of maximum light, waterproofness, vermin-proofness, and the assurance that fire cannot destroy a factory or mill.

In making clear this general fireproof property of reinforced concrete, a picture was shown of the recent fire in the Dayton Motor Car Works, at Dayton, Ohio. In this fire the fire started on the fourth floor of a six-story reinforced concrete factory but recently completed. Fire doors had not been installed between the concrete building and the old five-story first-class mill construction building. Although the fire department realized at once that the concrete building was able to take care of itself and devoted their entire attention to the mill constructed building, the fire spread through the unprotected openings and gutted three stories of the brick building, cracking the walls and completely ruining the structure. The fire on the fourth floor of the concrete building, burned itself out without damage to the rest of the building, and two days after the fire, the burnt out floor was

tested to twice the live load it had been designed for, and shortly thereafter new machinery was being installed on this floor.

The other points taken up by Mr. Turner in his comments upon the lantern slides were the speed of construction possible with reinforced concrete construction. Mr. Turner was conservative in his statements as to costs and general conditions existing to-day in the reinforced concrete industry. The general tone of his remarks, however, was most optimistic, and his belief in the future of this method of construction was apparent throughout his address.

Merrill Watson, of the Expanded Metal Engineering Company, spoke for a few minutes on the permanency and absolute fireproofness of concrete. In connection with these topics, Mr. Watson referred particularly to the conditions existing at the present time in the wholesale dry goods district, where there are a number of merchants carrying very valuable stocks of goods on which they cannot obtain insurance to the full value, due to the concentrated valuation in that district. Each year sees a reduction in the amount of insurance which the fire insurance companies will place in this territory. The chances of conflagration are so great that they cannot afford to carry anywhere near the full value of the property represented there. These conditions are due solely to the non-fireproof character of the buildings in this district. Mr. Watson made a plea to the architects to insist on concrete buildings for their clients under such conditions as these.

There were a number of slides shown by F. G. Webber, of the Webber Construction Company, in description of a building which they have recently completed on the northwest corner of Fortieth street and Broadway, New York. This job was rushed through in quick time, notwithstanding severe winter conditions.

Mr. Norris, of Emerson & Norris, of Boston, closed the evening's discussion with an interesting illustrated talk on artificial stone and ornamentation and decoration of reinforced concrete.

High-Pressure Fire Service.

THE rapid growth of our large cities has occasioned heavier demands on the fire departments and water supply of these cities for fire service. In 1904 Greater New York realized the need of improvement of its fire service, on account of the ever increasing congestion in business sections and increased height of buildings. The result of this growth was an increasing hazard to human life and property in case of fire, and consequently high insurance rates. In order to meet these conditions, the city engineers made a careful study of the requirements, estimating possible requirements of water, quantities and pressures, basing their estimates on former fires in New York and other large cities. To cover the areas in question, two high-pressure fire pumping stations were decided upon as adequate for New York city proper, and two such stations for the Borough of Brooklyn.

As this article treats principally of one of the Brooklyn stations, it will suffice here to make a brief outline of the supply and service in the Borough of Brooklyn. The main station is located at Furman and Joralemon streets; the reserve station is located at Willoughby avenue and St. Edwards streets. The magnitude of the Brooklyn system will be better understood from the fact that it comprises approximately five miles of 20-in. pipe, six miles of 16-in. pipe, ten miles of 12-in. pipe, and one and a half miles of 8-in. pipe, making a total of over twenty miles of pipe. To properly control these pipe lines there are sixty-eight 20-in., ninety-nine 16-in., one hundred and forty 12-in., and seven hundred and five 8-in. gate valves. There are 681 hydrants, each hydrant being provided with four nozzles, with the main valve operating against pressure, and independent valves for each nozzle. There are also twenty-four fire boat connections of special two-nozzle hydrants, that the pumps on the fire boats may be utilized for augmenting, in time of extreme need, the service of the stationary pumps at the pumping stations.

The service mains are cross-connected

in such a manner that in the event of a break, repairs may be made without effecting any hydrants except those located in the block in which the break occurs, and without appreciably effecting the supply or pressure on the remainder of the system. With the advent of these high pressure pumping stations, it is not the intention to relegate the fire engine to the past, but to supplement its work, and furthermore, to accomplish work that could not be accomplished with the fire engine. The need of higher pressures than can be obtained from steam fire engines now in use has long been felt. Hence the adoption of an independent set of mains, with hydrants, and pumping stations to deliver water at the hydrants at sufficiently high pressures, without further pumping.

The territory covered by this high pressure system extends along the East River water front from the Erie Basin to the Navy Yard, extending at the northerly end far enough in an easterly direction to include the down-town business section, comprising a total area of approximately 1,360 acres, with mains extending in a lengthwise direction approximately three miles, and over a width of from a few feet up to a mile at the widest point.

The main station is designed and connected so that water may be taken either from the city domestic supply mains, or in case of a shortage of fresh water for any cause, the supply may be taken from the East River. By the use of suitable vacuum pumps, automatically operated, salt water, or East River water, is held in the salt water mains at all times, it being only necessary to open the gates between salt water mains and the pump mains within the station, to deliver salt water to the pumps.

The reserve station is designed for taking water only from the domestic pressure mains, being located at some considerable distance from the water front. There are two suction lines, which terminate in the station below the floor line, in concrete lined trenches, covered by heavy cast iron floor plates, on which are mounted the floor stands for the valves. Either of these two suction lines will supply sufficient water for the entire station, this making the station in duplicate, so far as water supply is concerned.

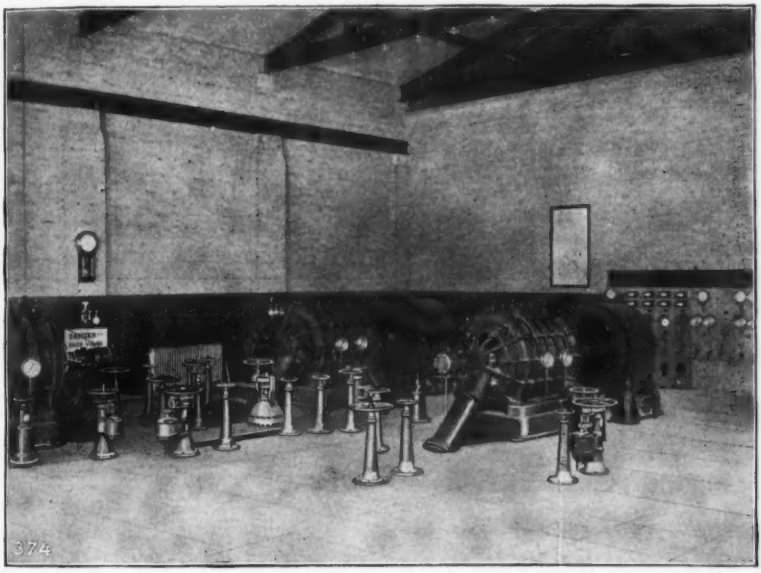
The main station has two regular feeder lines, and one reserve line, any or all of which may be supplied from any one of three power stations. The reserve station has one regular feeder line, and one reserve line, either of which may be supplied from any of the three power stations. Current for operating the motors which drive the pumps is 3 phase, 25 cycle, 6,600 volts, and is supplied by The Edison Electric Illuminating Co., of Brooklyn, or in case of failure of their two stations, by the Brooklyn Rapid Transit Company. Current for lighting the station and for driving auxiliary apparatus, such as motors for operating oil switches and valves, is 220 volts direct, and is supplied by the Edison Electric Illuminating Co. of Brooklyn.

Until experience should suggest modifications, the stations will be operated as follows: The system is divided by an imaginary line through Fulton and Court streets into two districts, the main and reserve districts. Upon an alarm coming in from the reserve district, for example, the operator at the reserve station will immediately start up one pump and put pressure requested by the fire department, on the entire system of mains; and it will be his duty to maintain this pressure by the running of additional pumps if necessary, unless notified by the Fire Department, who can communicate with him over the private telephone system from the scene of the fire. Should the operator at the main station notice by means of pressure gauges that the reserve station did not start when requested to do so, he is then to put pressure on the mains. The nozzle pressures of the fire streams can be varied by the firemen, either by throttling at the hydrant or by notifying the station operator.

The buildings for both stations are especially designed for the service; are substantially constructed of brick, with steel trusses and tile roofs. The architectural features and general dimensions of buildings will be more readily

appreciated by reference to the view of the exterior of the reserve station. The plan and arrangement of the buildings is fully shown in the photographs of the interior.

The reserve pumping station is arranged for an ultimate installation of six electric motor driven, multi-stage, turbine pumps. At present there are three such pumps installed, giving a station output of 9,000 gallons of water per minute, against a total head of 700 feet, at a total efficiency of 66½ per cent. from electrical input to water output. The amount of water is automatically measured by means of Venturi meters, and registered on a recording dial; the pressures of suction and discharge are measured by recording instruments; and the electrical input to the station is recorded by a recording wattmeter. Thus a running record of the station is kept, as well as the total intake and output. On account of the importance of the work, and the need of the same at critical times, when large property losses are threatened, and by reason of the high pressure under which the system must operate, the utmost care has been used in the manufacture of all the parts, the material being rigidly inspected during the entire process of manufacture. This rigidness of inspection, together with the high factors of safety used in designing the apparatus, assure continuous operation, even under the most trying conditions of fire service.



RESERVE STATION—VIEW OF MOTOR PUMPS, VALVE STEMS, AND SWITCHBOARD.

The pumps and motors are so designed that the various parts are interchangeable, and parts which are worn may be easily replaced, a minimum amount of time being required to make repairs. The pumps are of the multi-stage turbine type, of six stages, the water entering at one end of the pump, and being discharged at the last stage, or opposite end of the pump, the pressure per stage amounting to 117 feet. The water is discharged radially from the impellers, through guide or diffusion

vanes, and thence directed by return passages to the next stage, and so on until the last stage, where the water is discharged from the diffusion vanes to an annular discharge chamber, to which the discharge piping is connected. As will be noted from the accompanying photographs, the pumps are of heavy design, and thoroughly ribbed to withstand the high pressure. Both the impellers and guide vanes are of bronze to resist corrosive action. Each pump is designed for a normal rated capacity of 3,000 G.P.M., against a total head of 300 lbs. discharge pressure, at 735 R.P.M., and has shown an efficiency of 70% under test, at the rated head. Each pump is direct connected, by means of a flexible coupling, to an 800 H.P., 25 cycle, 6,600 volt, four-pole, A. C. motor, operating at a synchronous speed of 760 R.P.M., making the full load speed approximately 735 R.P.M. The motors showed an efficiency of over 92%, with a power factor of 93%. The heating was under 40 degree C. after a full load run of 24 hours, and 55 degrees after a two hours' run at 25% overload. The bearings are ring oiling, the oil reservoirs holding large quantities of oil. Both the pump and motor are mounted on one sub-base, thus making each unit self-contained.

The water supply to the station is from two 20-in. mains, each connected to independent street mains, and connected to form a loop within the station, so in case of a break in one main there is still left one to draw on. Gates are provided for cutting off these incoming mains when desired. All the pumps are connected to this 20-in. suction loop, by 12-in. pipes, with gate valves for cutting off any one of the pumps when desired.

All the pumps deliver through 10-in. pipes, into either of two 16-in. discharge mains, which are also connected to form a loop within the station. The pumps operate against a pressure of 300 lb., this pressure being reduced, as required, by a regulating valve. As the fire hydrants are likely to be shut off at any time without notice to the station, there is provided between the discharge pipes and suction pipes of each pump, a relief valve which can be set to relieve at any pressure from 100 to 300 lbs., the waste, or excess water returning to the pump suction. All pipes, fittings and valves were submitted to a hydrostatic pressure test of 600 lbs. per sq. inch at the shops, and after being laid were tested to 450 lbs. per sq. in.; and under these conditions, leakage per lineal foot of joint in 24 hours allowed in the contract was four gallons. Pipe outside of the station, leading to the supply and discharge lines, is a bell and spigot. Pipe inside of the station is cast iron, with male and female flanges. All fittings are of cast steel Copper and lead gaskets are used for male and female flanges and paper gaskets for straight flanges. The gate valves are of a special design, with spherical tops, and are constructed of steel castings. The larger and more important valves are motor driven. All the valves are operated from the main floor, and are provided with cast iron floor stands, with polished hand wheels. The motor operated valves have their motors mounted on the floor stands in a vertical position, and operate the valves through spur gears. An intermediate gear is provided, and is so arranged that it can be thrown out of mesh with the pinion and large gear, so that the valve can be more easily operated by hand.

For the city, the work was directly under the supervision and control of the Department of Water Supply, Gas and Electricity, Borough of Brooklyn; the preliminary work was started by I. M. Verona as Chief Engineer, and later followed by John W. McKay, under whose supervision the work has been completed and tested, with Joseph Goodman, Assistant Engineer, in active charge of the work.

The contractor for the street mains was John J. Cashman, of Brooklyn, the fire hydrants were manufactured by the A. P. Smith Mfg. Co., of Newark; the contractor for the buildings was Chas. H. Peckworth, of New York; and the D'Olier Engineering Company, of Philadelphia and New York, were the contractors for the complete electrical and hydraulic equipment for both stations.

New Combined Steam Hammer.

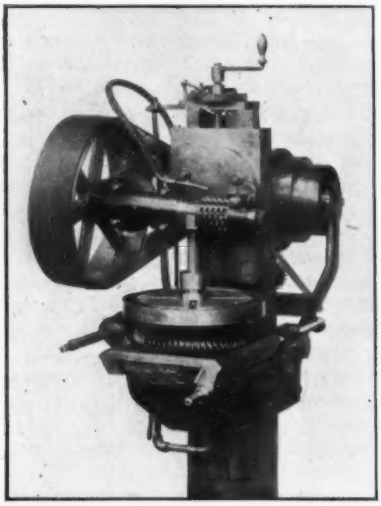
THE accompanying illustration shows an entirely new design of hammer as up to the present time no steam hammers have been built of the single frame type in which the anvil block is attached to and forms a part of the main frame casting, and in this particular point, they are, therefore, entirely different from the ordinary steam hammer, where the anvil block is a separate casting and is not connected in any way with the bed

plate. The result is that there is a certain amount of shifting movement to the anvil block of the ordinary steam hammer when the blow is struck, which movement would prevent the hammer being used, except on the roughest sort of formed work: that is, the alignment of the dies is not close enough to be used in most kinds of die work. The main frame casting is made of open hearth steel, and this is also of very much importance, as the shearing strains which come on this casting from the continued hammering, besides the liability of crystalization from the constant shock and jarr of the blow, are such that steel is the only material which will stand up to the service required. The fact that the hammer has balanced valve motion gives to its operation an extremely sensitive control, so that it can be well operated by the foot treadle, and this does away largely with the necessity of an operator. These hammers will be found a very useful tool in any kind of a shop where iron or steel is to be bent or forged into shape. It is especially suitable for dressing tools used in planers, lathes, boring mills, etc., and all such work can be very handily done by the blacksmith. The construction of the hammer is such that it is essentially a self-contained machine, and therefore not needing very much foundation and being very heavy, so that it absorbs the shock and blow of hammering, there will be very little vibration of the surrounding ground. It has been frequently demonstrated that the addition of a steam hammer is of so much assistance, even where a single blacksmith fire is used, that a machine of this kind becomes almost a necessity, and that it will, besides increasing the output, enable the blacksmith to turn out a far better quality of work. The fact, also, of the hammer's being capable of being operated by compressed air as well as by steam is also of interest, owing to the present tendency towards the operation of gas engines as a means of obtaining power, and where they are used, compressed air is almost always available. The hammer illustrated is made by the Buffalo Foundry & Machine Co., Buffalo, N. Y.

Farwell Automatic Gear Hobbing Machine.

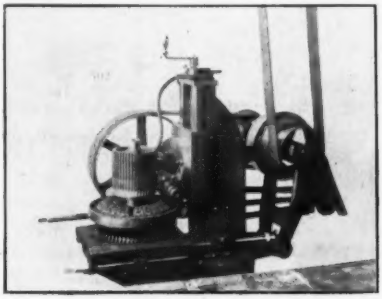
A GEAR hobbing machine of very simple and rigid form is being placed upon the market by the Adams Company of Dubuque, Iowa. The system of cutting spur gears by the use of a hob has been proved to possess so many advantages over the old method of milling one tooth at a time that the gear hobbing machine is probably destined to displace entirely the or-

dinary automatic gear cutter. The rapidity of the work is far ahead of any system of milling or planing gears, being a continuous cut from start to finish up to the full capacity or strength of



the hob teeth. The accuracy of the work and the smooth, quiet running of the gears produced on the gear hobbing machine can be approached only, but not equalled, by the generated gear of the gear planer. The gear hobbing machine generates the teeth theoretically correct and all the teeth are exactly the same thickness and form. The builders of the Farwell automatic gear hobbing machine claim that it will cut accurately and economically a large per cent of the gears used in manufacturing, and its cost is only a fraction of that of other machines of the same capacity. By equipping it with a full set of change gears and a full set of hobs it is complete for all sizes and pitches of gears up to its capacity of 12 in. diameter and 6 in. face. This capacity will cover nearly all of the requirements for automobile transmission gears, lathe, boring mill, milling machine and other machine tool change gears, drill press and other back gears. It requires one hob for each pitch desired. One hob of the desired pitch will cut gears with any number of teeth up to the full swing of the machine table, 12 inches. The same hob will also cut worm gear wheels. The spindle is driven by a 4 in. belt on a 15 in. diameter pulley from a swinging cone pulley shaft, and the drive belt is kept taut in all positions of the spindle head by a distance rod provided with turn buckle for adjusting. Three hob speeds are obtained by the three step cone pulleys for 2½ in. belt on the swinging shaft and countershaft. The countershaft is provided regularly with one 4 x 10 in. friction clutch pulley. Two pulleys may be provided where more spindle speeds are desirable, but as the hobs do not vary greatly in diameter three spindle speeds are deemed sufficient to take care of the requirements. The spindle head is swiveled upon the saddle so that the hob may be set at the proper angle for cutting spur gears with different pitches or for cutting worm gears. This saddle is gibbed to the slide on the column for providing vertical feed. The hobs for cutting spur gears are regularly right hand, single thread, 3 in. diameter, 3 in. long, with 1¼ in. arbor hole and ¼ in. keyway. Other sizes, of course, may be used.

A rigid stop is provided, against which the table saddle may be run, to give the proper depth of the teeth. Instead of setting this stop by micrometer graduations which require much care in set-



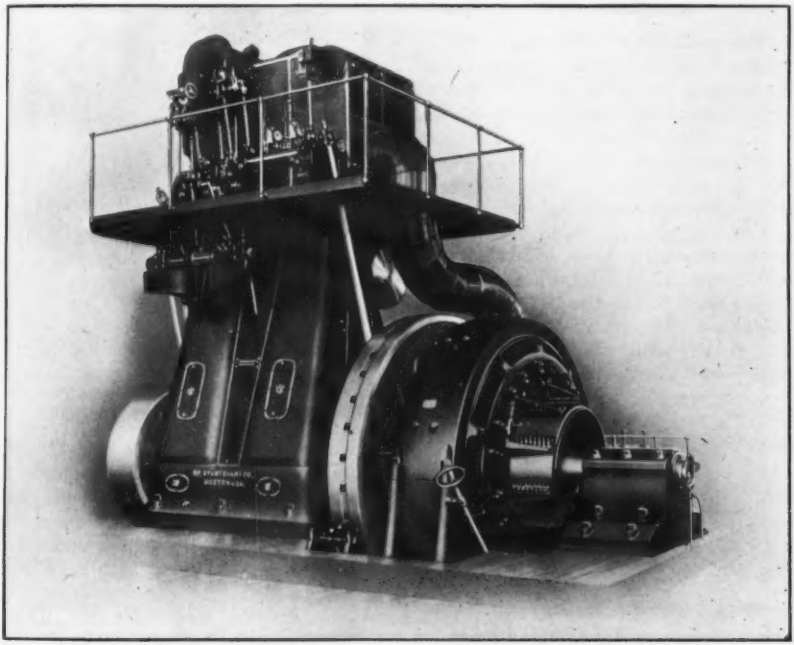
ting, a hardened steel gauge is provided which is of a thickness equal to the depth of the teeth of the pitch desired. To set the stop, the table is advanced until the blank contacts the hob. The stop is then screwed up against the

gauge block. When the gauge block is removed and the table is advanced to stop, the correct depth is obtained. After the stop is set for a given diameter any number of gears of same size are cut the proper depth by simply moving table to this rigid stop. A careless operator cannot spoil work as is often done when depth is set by micrometer gauge.

Generating Sets with Compound Engines.

WHILE it is true that the economy of a power plant depends upon the efficiency of the boilers, furnaces, draft, economizers, etc., the economy of the engine itself is the factor that determines the amount of fuel that must be purchased. With the same efficiency of boilers, etc., a compound condensing engine will effect a saving of from 20 to 40 per cent over a single-cylinder engine, the amount of saving depending, of course, upon the conditions, the form of valve gear, the speed, etc. The installation of the compound engine should be a matter of careful consideration and calculation. While it is a fact that in some localities fuel is very cheap, there are not many places where the cost of fuel is so low that it does not pay to install a compound engine. As a rule the compound engine will not only pay good interest on the additional cost, but will also in a short time pay the additional cost itself. Another feature to be noted in connection with the compounding is the relative cost of equipment for steam generation. Since the compound engine uses much less steam, the boilers, pumps, etc., may be correspondingly smaller.

For many years the B. F. Sturtevant Company has been making small generating sets in such sizes that prevent the attainment of great economy. The



larger sizes now being placed upon the market by this company, that is, 150 to 500 K.W. generating sets with compound engines, admit of devices for saving steam. The engines of these sets are of the four-valve type in order that the events of the stroke may be separately adjusted and the clearances reduced to a minimum. Grid-iron valves

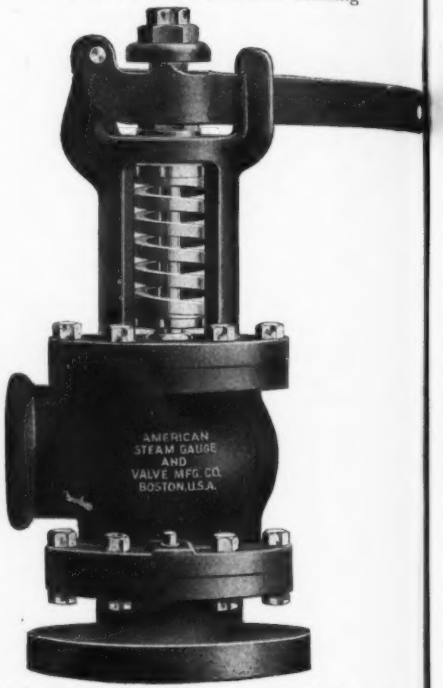
are used to get the advantages of this type. The valves are placed horizontally in chambers provided for the purpose in the cylinder castings, both the ports and the valves being removable and of the gridiron type. Upon the face of each steam valve slides an auxiliary gridiron valve, which being connected to the governor, controls the cutoff. The exhaust valves and the main valves are actuated by the eccentric on the shaft, the proper motion being given by levers and rockers. Upon the high-pressure side of the engine a modified Rites governor is placed in the regulating wheel, while a larger fly-wheel is placed upon the shaft at the generator end.

The generators are of the Sturtevant ten-pole type direct-connected to the engine shafts by a flange coupling. They are designed for a wide range of load, and require little or no attention. Ample cooling surfaces and mechanical ventilation render the generators free from heating and burn-outs. These machines are capable of carrying an overload of 33⅓ per cent for two hours without injurious sparking, and an overload of 100 per cent momentarily without destructive sparking or heating. The insulation will not deteriorate after continuous operation at normal temperature.

Carbon brushes of a size that the current density will never exceed thirty amperes per square inch, are held in the latest design of sliding-socket shunt brush holders, which are clamped on a composition frame, insulated from the brush ring itself. Each brush holder can be adjusted separately and removed for cleaning and repairs, or the entire brush ring may be rotated by a hand wheel.

American Outside Spring Pop Valve.

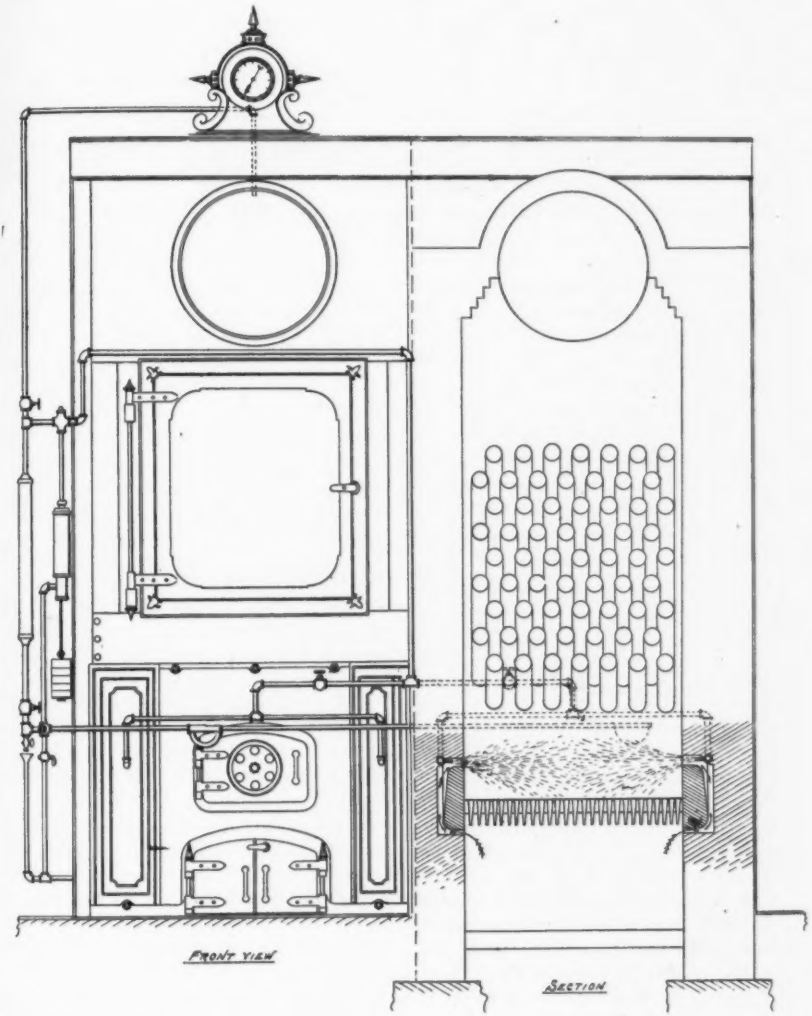
WITH the rapidly increasing use of superheated steam it has become necessary to place on the market a spring loaded pop safety valve of a type suitable for the high temperature of superheat steam. To meet this demand the American Steam Gauge & Valve Mfg. Co., Boston, have designed a type of valve having an outside spring and constructed of metals to withstand these conditions. The entire body and outer casing of the valve are made of steel. The seat bushing which guides the valve proper and the valve itself are made from a solid nickel casting. The valve top or open spring casing is extended into the main body of the valve and is fitted with solid nickel bushing



which is recessed and acts as a suitable guide for the spindle. The spindle is fitted with a loose flange or spring seat having a spherical bearing which, together with the follower or top plate which guides the spring at the top and which is also fitted with a spherical bearing, properly distributes the load on the spring under compression, preventing undue friction of the moving parts. The American adjustable blow down ring is used as a means of adjusting the closing point of the valve. The lifting levers may be either of the straight horizontal type or of the compound link drop lever type so proportioned as to permit the lifting of the valve from its seat one-eighth of its diameter.

Automatic Smoke Preventer.

THE following tables show the percentage of economy in fuel accomplished by the use of the automatic combustion device and smoke preventer made by the Empire Steel and Equipment Company, 141 Broadway, New York. The first table shows the details of tests made at its boiler plant of Igue Brothers, Newark, N. J., on December 26th last, and the second table gives the results of tests made at the boiler plant of the Robinson-Roder Co., also of Newark, on February 27th.



RECORD OF TEST

Boiler Plant of Igue Brothers, Newark, N. J., December 26, 1907.

	Without Device.	With Device in Operation.
Duration of test.....	7½ hrs.	7½ hrs.
Coal consumed	4,280 lbs.	4,395 lbs.

Ash removed	241 lbs.	220 lbs.
Average steam pressure	88 "	90 "
Average feed water temperature	206°	203°
Water evaporated	36,567 "	39,312 "
" " (from and at 212°) per lb. of coal	8.07 "	9.6 "
Water evaporated (from and at 212°) per lb. of combustible	8.5 "	10.2 "

Percentage of economy per lb. of coal, 18.9%.

Percentage of economy per lb. of combustible, 20%.

RECORD OF TEST

Boiler Plant of The Robinson-Roder Co., Newark, N. J., February 27th.

	Without Device.	With Device in Operation.
Coal consumed	1,807 lbs.	1,555 lbs.
Average steam pressure	72 "	76 "
Feed water temperature	160°	160°
Water evaporated	14,437 "	14,812 "
" " (from and at 212°) per lb. of coal.	8.75 "	10.7 "

Percentage of economy shown by use of the Combustion Device, 20.2%.

NEWS SUPPLEMENT

The Engineering Magazine—June, 1908

Personals.

—Herbert C. Petty was elected a director of the Crocker-Wheeler Co., Ampere, N. J., on May 13.

—D. D. Pendleton has been appointed the Pittsburg representative of the Wheeler Condenser & Engineering Co., Carteret, N. J., with offices in the Frick Annex.

—Professor Ira O. Baker, for 34 years connected with the Department of Civil Engineering of the University of Illinois, has been granted by the Trustees leave of absence for one year from July 1, 1908.

—H. G. Perring, secretary of the Engineers' Club of Philadelphia, and formerly engineer with the Keystone Fireproofing Co., has been secured by The General Fireproofing Co., Youngstown, Ohio, as district manager at Philadelphia, with offices in the Drexel Building.

—Arthur Koppel, the railway engineer, died recently in Germany. Mr. Koppel died in his fifty-seventh year at Baden Baden, where he was under treatment. Born in Dresden in 1851, he entered the structural iron business on his own account when only 25 years old. He assisted in making the narrow gauge railway known throughout the world by using it in all his factories and by urging other large concerns to do likewise. He was the inventor of what is known as the "flying railroad system," namely, two rails on portable steel ties made in twenty-foot sections which can be laid by a couple of men easily. He was also the inventor of a dumpcart known as the Koppel cart, which is in use all over the world.

Industrial Notes.

—Jenkins Bros. announce the removal of their Chicago store from 31-33 No. Canal Street to 226-228 Lake Street.

—Turner Construction Co., 11 Broadway, New York, has opened a branch office in the Builders' Exchange Building, Buffalo, with James L. Bruff in charge.

—Union Gas Engine Co., San Francisco, announce that they have secured the services of John F. Willard as manager, and also their removal to 503-505 Mission Street.

—The Hoppes Manufacturing Co., Springfield, Ohio, reports the removal of its New York office from the Havemeyer Bldg. to new quarters in the Singer Bldg., 149 Broadway.

—Walter B. Snow, publicity engineer, has recently increased his facilities by removal to larger quarters at 170 Summer Street, Boston, and the establishment of an addressing and mailing department.

—George A. Kimball, chief engineer of Elevated and Subway Construction for the Boston Elevated Railway, has awarded the Raymond Concrete Pile Company, Chicago, the contract for placing concrete piles for the foundations of the incline walls, at the north approach to the East Cambridge extension of that road.

—The Massachusetts Fan Co., Watertown, Mass., is furnishing drying apparatus for the new plant of the Watsontown Brick & Clay Product Co., Watsontown, Pa. This apparatus consists of a 200-inch fan with engine and heater, and an 84-inch Davidson exhaust fan with engine. The

present capacity will be 60,000, but it will ultimately be increased to 85,000 brick.

—Just at the close of 1907, one of the largest orders ever placed for mechanical stoking equipment was received by the Westinghouse Machine Company, aggregating 14,400 boiler horse power. This was for one of the large Brooklyn power stations operated by the Transit Development Company, New York. This order comprises 24 stokers suited to 600 h.p. boilers of the B. & W. water tube type.

—Turner Construction Co., New York, have just been awarded the general contract for constructing the new warehouse for Fred'k Loeser & Co., Brooklyn. This building will be 170' x 140' in plan, eight stories, basement and sub-basement, as well as roof and pent houses. Reinforced concrete throughout, excepting only the Livingston St. front, which will be brick with terra cotta trim. Work will be begun at once. Wm. Higginson, Architect.

—The following companies have moved to the Hudson Terminal Buildings, 50 Church St., New York: The Electric Controller & Supply Co., Standard Gauge Manufacturing Co., The Watson-Stillman Co., Brown Hoisting Machinery Co., Morse Chain Co., The Hayward Co., Cutler-Hammer Manufacturing Co., Wellman-Seaver-Morgan Co., Providence Engineering Works. The following to the Hudson Terminal Buildings, 30 Church St., New York: General Electric Co., Ball & Wood Co.

—J. G. White & Co., Inc., New York, have been awarded the contract for engineering and constructing a complete hydro-electric plant, with transmission lines, substations, etc., for the Central Georgia Power Co. This plant will be built on the Ocmulgee River, about thirty-six miles above Macon, Ga., supplying power to that point and to other points in the vicinity. The normal capacity of the plant will probably be 12,500 kw., generated by water-wheels under a hundred foot head. The crest of the dam will probably be seven hundred and fifty feet.

—Retrospective of the development during the past year of the steam turbine, the accompanying figures reported by the Westinghouse Machine Company are interesting as tending to controvert the general impression that the turbine business suffered heavily during the year. Although one month's business in 1906 still holds the record at 62,100 kw., the year 1907 was marked by an average demand quite as large. As late as July, orders for 34,750 kw. were taken during that month as compared with 25,750 for July, 1906, which is a particularly gratifying showing. For the first nine months of each year the demand for turbines was as follows: 1907, 158,550 kw., and for 1906, 152,400 kw. Or, taking the middle six months of the year, from April to September inclusive, thus excluding the usual midwinter activity, as well as the late depression, the average per month is as follows: 1907, 15,833 kw.; 1906, 14,365 kw.

—The semi-annual meeting of The American Society of Mechanical Engineers will be held in Detroit, June 23-26. Among the papers to be presented at this session are "A Method of Cleaning Gas Conduits," by W. D. Mount; "A Method of Checking Conical Pistons for Stress," by Prof. George H. Shepard; "Clutches," with special reference to automobile clutches, by H. Souther; "Horse-Power, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. L. S Marks; "Some Pitot Tube Studies," by Prof. W. D. Gregory; "The Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck; "A Journal Friction Measuring Machine," by Henry Hess; "A By-Product Coke Oven," by W. H. Blauvelt; "Tests of Some High Speed Steam Engines," by F. W. Dean. There will be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the Promotion of Engineering Education and the Society of Automobile Engineers will also hold their annual meeting in Detroit at this time, which will enable members of each Society to participate in the sessions of the other.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.

Advertising Mediums.

"What Makes the Best Advertising Medium? What Are Its Elements of Strength? How May it be Selected?" by Emerson P. Harris, 253 Broadway, New York. A most admirable brochure discussing this important subject with unusual intelligence, as the result of more than thirty years' experience in technical and trade journalism. The author is Editor and Publisher of *The Selling Magazine*, and he will be pleased to send a complimentary copy of the pamphhlet to those who are interested in the science of advertising.

Auto-Trucks.

WESTINGHOUSE MACHINE CO., East Pittsburgh —Well-printed catalogue devoted to an illustrated description of storage battery auto-trucks for industrial railways. 6 by 9 in.; pp. 18.

Blowers.

L. J. WING MFG. CO., West St. Bldg., New York—Leaflet illustrating and describing Wing's turbine blower system of mechanical draft. 6 by 9 in.; pp. 4.

Buckets.

INSLEY IRON WORKS, Indianapolis—Folder giving a brief illustrated description of controllable drop bottom buckets, together with tables giving dimensions. 6 by 9 in.; pp. 6.

Cableways.

NEW YORK CABLEWAY & ENGINEERING CO., 2 Rector St., New York—Folder illustrating and describing cableways for all purposes. 5 by 7¾ in.; pp. 10.

Cement.

STRUTHERS FURNACE CO., Struthers, O.—Well-printed catalogue containing a brief description and illustrations of a number of buildings on which this cement was used. 10½ by 9 in.; pp. 32.

Chemical Fire Engines.

KANAWHA CHEMICAL ENGINE MFG. CO., Charleston-Kanawha, W. Va.—Booklet illustrating and describing various types of chemical fire extinguishing engines especialiy adapted for use in factories, mills, foundries and industrial plants. 3½ by 6 in.; pp. 20.

Chucks.

SKINNER CHUCK CO., New Britain, Conn.—Catalogue and price list illustrating and describing lathe, drill and planer chucks. 4 by 7¼ in.; pp. 40.

Clutches.

MERCHANT & EVANS CO., 517 Arch St., Philadelphia—Catalogue treating clutches for motor cars, boats and all industrial uses. Illustrated. 8 by 11 in.; pp. 42.

Concrete Machinery.

NIMS CONCRETE MACHINERY CO., Philadelphia, N. Y.—Booklet illustrating and describing continuous batch mixers for concrete, sand, lime, brick and mortar, with measuring attachment. 5¼ by 8 in.; pp. 16.

Concrete Mixers.

EUREKA MACHINE CO., Lansing, Mich.—Pamphlet describing concrete mixers, together with specification sheets. Illustrated. 8 by 11 in.; pp. 8.

KOEHRING MACHINE CO., Milwaukee—Catalogue illustrating and describing concrete mixers, together with tables giving sizes and capacities. 7 by 5½ in.; pp. 32.

Cooling Towers.

EDWIN BURHORN, 71 Wall St., New York—Catalogue illustrating and describing cooling towers. Also contains many views showing towers recently erected. 8¼ by 6 in.; pp. 48.

Crushers.

STURTEVANT MILL CO., Boston—Bulletin illustrating and describing plate steel crushers. 6¾ by 9¼ in.; pp. 12.

Drill Presses.

HENRY & WRIGHT MFG. CO., Hartford—Well-printed catalogue illustrating and describing sensitive and radial ball bearing drill presses. 6½ by 8½ in.; pp. 54.

Electrical Equipment.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletins Nos. 4576, 4578, 4579 and 4584 illustrating and describing oil break switches; railway motor controllers; luminous arc headlight and motors respectively. 8 by 10½ in.

ELECTRIC CONTROLLER & SUPPLY CO., Cleveland—Bulletin No. 281 illustrates and describes, with prices and sizes, crane fittings, knife switches, circuit breakers, rosettes, switchboards, limit stops, insulator supports, flexible couplings, etc. 7½ by 5 in.; pp. 24.

Elevators.

KAESTNER & CO., 241 So. Jefferson St., Chicago—Catalogue illustrating hydraulic, steam and electric elevators for passenger and freight service. 8 by 11 in.; pp. 36.

Engineering Instruments.

HANNA MFG. CO., Troy, N. Y.—Catalogue illustrating and describing, together with prices, weights, etc., engineering, surveying, nautical, astronomical and mining instruments. 5¼ by 7½ in.; pp. 72.

Exhaust Heads.

OHIO BLOWER CO., Cleveland—Well-printed catalogue in two colors, devoted to an illustrated description of cast iron exhaust heads. Steam and oil separators are also given a place. 6 by 9 in.. pp. 80.

Gas Engines.

ALAMO MFG. CO., Hillsdale, Mich.—Catalogue No. 27 is devoted to an illustrated description of gas, gasoline and distillate engines, adaptable to a wide range of service. 9 by 7 in.; pp. 36.

BRUCE-MERIAM-ABBOTT CO., Cleveland—Cata-

logue A is devoted to an illustrated description of vertical gas engines for electric lighting, pumping and general power purposes. 6 by 9 in.; pp. 16.

DEAN GAS ENGINE & FOUNDRY CO., Newport, Ky.—Catalogue devoted to an illustrated description of gas, gasoline, alcohol and distillate engines. Also gives net prices, dimensions, etc. 9 by 6 in.; pp. 40.

Gears.

BOSTON GEAR WORKS, Norfolk Downs, Mass. —Catalogue E1 gives prices and dimensions of chains, sprockets, bearings, steering devices, etc. Illustrated. 3½ by 6 in.; pp. 88. Also a circular containing specifications and price list of standard steel mitei and bevel gears with generated teeth.

Hoisting Machine.

NATIONAL EQUIPMENT CO., Monadnock Block, Chicago—Catalogue A illustrates and describes hoisting machinery, derricks and material handling plants for contractors, quarrymen, sand dealers, railroads, loggers, bridge builders, manufacturing plants, etc., together with tables giving dimensions, weights, etc. 6 by 9 in.; pp. 40.

Ice Breaker.

THE CREASEY ICE BREAKER AND ICE USERS' HANDBOOK, published by Joseph S. Lovering Wharton, 3138 N. 17th St., Philadelphia, while devoted primarily to the description of the Creasey ice breaker, contains in addition drawings showing arrangements for handling and breaking ice in refrigerator car icing stations, ice cream manufacturing establishhments, meat, fish and game shipping and packing houses, dairies, restaurants, hotels, hospitals, etc. It also contains short chapters on "Ice and Its Uses," "Cold Storage Temperatures," "Ice Cream Freezing" and "Refrigeration With Ice." It is shown, that for refrigeration on a small scale, it is often more economical and convenient to employ broken ice, or broken ice and salt, than to install refrigerating machinery, as uniform temperatures can be secured at a moderate cost with much less attention and with unskilled labor. 3¼ by 6¼ in.; pp. 28.

Lubricant.

OLNEY & WARRIN, 66-68 Centre St., New York —Folder describing Howard grease as a lubricant for shafting and bearings. 3¼ by 6¼ in.; pp. 6.

Motors.

LINCOLN MOTOR WORKS CO., Caxton Bldg., Cleveland—Bulletin No. 10 illustrates and describes variable speed motors with speed ranges up to one-to-ten. Also gives a partial list of users. 8 by 10½ in.; pp. 16.

Power Transmitting Machinery.

FALLS RIVET AND MACHINERY CO., Cuyahoga Falls, O.—Catalogue and price list A describes pulleys, shafting, hangers, pillow blocks, couplings, collars, and friction clutch pulleys and couplings. Illustrated. 5½ by 7½ in.; pp, 216.

Power Transmission Machinery.

W. A. JONES FOUNDRY AND MACHINE CO., 142 W. North Ave., Chicago—Catalogue devoted to an illustrated description of power transmitting appliances. Machinery for elevating, conveying and handling all kinds of material are also treated. 3½ by 6 in.; pp. 96.

Reinforced Concrete.

ABERTHAW CONSTRUCTION CO., 8 Beacon St., Boston—Circular No. 16 illustrates and describes a number of reinforced concrete structures with brick and timber erected by them. 6 by 9 in.; pp. 24.

Roller Bearings.

HYATT ROLLER BEARING CO., Newark, N. J.— Bulletin No. 31 illustrating and describing roller bearing bushings, standardized for all conditions of speed and load. 6 by 9 in.; pp. 24.

Steam Engines.

AMERICAN BLOWER CO., Detroit — Catalogue No. 232 illustrates and describes types A and E vertical self-oiling steam engines. Also contains many tables giving much useful information. The catalogue is well printed. 7 by 8½ in.; pp. 64.

AMERICAN ENGINE CO., Bound Brook, N. J. —Bulletin No. 14 describes American-Ball angle-compound engines. Also contains tables giving dimensions in inches, horse-power, weight, etc., of angle-compound engines for belted and direct connected service. The bulletin is well printed and illustrated. 9 by 6 in.; pp. 32.

Steam Specialties.

THE LUNKENHEIMER CO., Cincinnati — 1903 illustrated catalogue and price list describing brass and iron valves, whistles, cocks, gauges, injectors, lubricators, oil pumps, oil and grease cups, etc., adapted to the requirements of all classes of machinery. The catalogue is bound in cloth and fully indexed. 5 by 7 in.; pp. 564.

Tool and Cutter Grinders.

W. H. LELAND & CO., Worcester—Catalogue containing a general illustrated description of universal tool and cutter grinders, together with specifications. 6 by 9 in.; pp. 16.

Vises.

EMMETT MFG. CO., Waynesboro, Pa.—Catalogue No. 7 contains an illustrated description, with prices and dimensions, of universal and standard vises. 3½ by 6¼ in.; pp. 16.

PITTSBURGH AUTOMATIC VISE & TOOL CO., Pittsburgh—Booklet illustrating and describing automatic double and single swivel vices. Also contains prices, sizes, weights, etc. 6½ by 4 in.; pp. 32.

Water Filters.

ROBERTS FILTER MFG. CO., 30th and Chestnut Sts., Philadelphia—Catalogue devoted to an illustrated description of pressure water filters and filter appurtenances. Also contains tables giving sizes, capacities, etc. 9 by 6 in.; pp. 72.

Water Tube Boilers.

SAMUEL SMITH & SON CO., Paterson, N. J.— Booklet giving a partial list of users of their boilers. Illustrated. 3½ by 6 in.; pp. 8.

RUST BOILER CO., Pittsburgh—Pamphlet giving the report of tests on Rust water tube boilers made by William Kent, A. M., M. E., Dean of the College of Applied Science, Syracuse University. Illustrated. 6 by 9 in.; pp. 12.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

HELP WANTED

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WANTED—A capable engineer to take charge of the mechanical production in a large Brass and Copper Rolling mill. Must understand the designing of machinery and possess full knowledge of all the latest improvements in rolling mill equipment. Must also understand the hiring and handling of help. Give full information as to practical experience. Address Box 120, care of THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 1-6

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PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

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IMPROVED MACHINERY

New Processes and Appliances

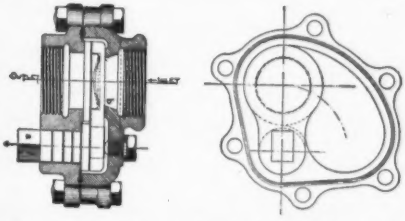
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A New Blow-off Valve.

A NEW blow-off valve has been put on the market recently by the Patterson-Allen Engineering Co., the Scully Steel and Iron Co., Chicago, being general distributing agents.

The valve is composed of two saucer-shaped bonnets, set together upon a high-pressure gasket with tap-bolts. Up-

on the lower bonnet is wrought a valve face. The valve slides upon this face, and is actuated by a substantial crank-arm, which, in turn, is actuated by a square-headed post. The square within the case actuates the crank-arm and extends through the bottom bonnet, being seated upon a ground joint, thus doing away with the necessity for a stuffing



box, or packing of any kind whatever. The post is operated by a box-lever placed thereon.

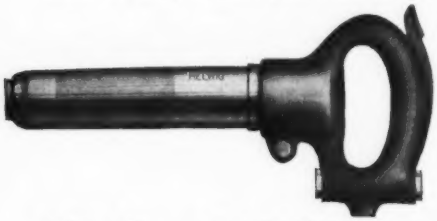
The seat in the lower bonnet is raised above the plane of the joint, the valve sliding laterally upon it, wiping it clean at each operation and eliminating the chance of any part of the deposit from the discharge being interposed between the steam tight surfaces when the valve is closed. The valve at all times is tightly pressed against the seat by the boiler pressure. This feature lends a very desirable quality to the repairing of the valve, as it may be resurfaced simply by the use of a file, should its surface become scored or eroded.

When the valve is open, the discharge opening is round, of the same diameter as the discharge pipe, the discharge and inlet nipples being arranged so close together that the discharge pipe might be considered continuous and uninterrupted. It will be further noted that the innermost facing of the inlet orifice is slightly choked, insuring the delivery of sediment-laden discharge into the outlet orifice with a minimum impingement upon any of the steam tight members of the valve.

The Helwig Pneumatic Hammer.

THE Helwig pneumatic hammer, a late product in the line of pneumatic tools and other labor-saving devices made by the Helwig Mfg. Co., St. Paul, Minn., embodies several new features which commend it to both purchaser and user. Its design is exceedingly simple, having few parts, and the absence of jar lengthens the life of the Helwig hammer. The valve is of piston type, both the valve and valve chamber are simple in design and very substantial in construction. The valve chamber is firmly imbedded in the barrel and cannot become displaced. The handle has a simple locking device of but one piece,

which locks it firmly to the barrel, and it cannot get loose. The shape of the handle is much liked by the operator because of its comfortable grip. It is drop forged from steel. The trigger is a one-piece steel drop forging. The long stroke hammer is furnished with either inside or outside trigger. The hose connection at right-angles with the barrel is advantageous. It is a desirable feature when working in close quarters and also



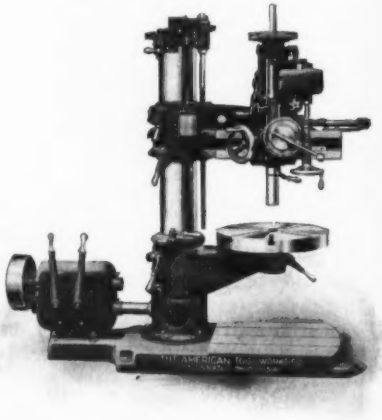
reduces the wear on the threaded connection. The Helwig chipping hammer does not operate except when the shank of the tool is in place. The wearing parts are hardened and ground. The great speed and power of this hammer, considering size and stroke, permit of its being operated in close and confined quarters and in places not heretofore accessible, thus saving a great amount of hand labor.

High-Speed Radial Drill.

THE introduction of high speed steel twist drills, with their enormous productive capacity and ability to stand up under speeds and feeds previously unheard of, also the inevitable supplanting of the upright by the radial drill for all around purposes, has led the American Tool Works Co., Cincinnati, Ohio, to bring out a full line of radials, having 2 ft., 2½ ft., 3 ft., 3½ ft., 4 ft., 5 ft., 6 ft. and 7 ft. arms, one size being herewith described.

The increased speeds and feeds possible through the most modern machine tools require that they have lubricating facilities superior to the older style machines. This feature has been thoroughly and carefully provided for in every bearing in this radial drill and is a factor which should not be overlooked in the selection and purchase of a machine from which the best results are to be obtained.

The feeding mechanism on the head provides four distinct rates of feed, covering a carefully chosen range, in geometrical progression, from .007 to .020 in. These feeds are all readily obtained by the simple turning of the knob on feed box until the desired feed shown on dial comes opposite a fixed pointer. This method of feed change is by far the simplest yet devised, as it requires no reference to index plates and subsequent handling of levers. The all-gear feeds, when supplied instead of belted feeds, insure vastly increased productive capacity, rapidity of change and positive action. Feeds operate through a friction, which permits a drill being crowded to its limit without strain to the feed works. Feeds can be automatically tripped at any position of spindle by adjustable trip dog and pointer, acting on the worm clutch. Depth graduations are on the



spindle, and all depths can be read from zero. The safety stop acts automatically at full depth of spindle, preventing breakage of feed mechanism.

The speed box is very powerful, of the geared friction type, providing four changes of speed, each being instantly available by use of the two levers shown. Frictions are extremely powerful, employing very few parts in their construction, which can thus be made of such

large proportions as to be free from slippage under the severest duty, and obviating the use of loose, delicate parts, a source of frequent breakage on most other makes of radial drills. There is absolutely no shock to the parts when throwing in any speed.

A motor of any type may be attached by various methods, connection being made either direct or through gear, chain or belt.

The spindle has sixteen changes of speed, ranging from 33 to 400 r.p.m., in geometrical progression, all immediately available without stopping the machine. This wide range of spindle speeds, advancing by close increments, combined with the exceptional driving power of the machine, renders the drill equally efficient with either ordinary or high speed twist drills of extreme sizes. The engraved speed plate enables the operator to select the proper speeds for both carbon and high speed drills, also for boring and tapping. The spindle is counterbalanced and has frictional quick advance and return.

The column is of double tubular type. The sleeve or outer column revolves on conical roller bearings, hardened and ground, and is clamped in any position by a V clamping ring, which can be moved around the column to suit convenience of operator. This makes the outer column practically integral with the inner column which extends almost the entire height, and has full bearings for outer column at both top and bottom. This gives the equivalent of a double column, affording exceptional rigidity.

The arm is of parabolic beam and tube section, giving greatest resistance to bending and torsional strains. Its design leaves the lower line parallel with the base, and thus permits work being operated upon in close proximity to the column without the necessity of an extreme reach of spindle. The arm is clamped to the column by two binder levers, obviating loose wrenches, and is provided with gib-screw, permitting the arm to work freely, without sagging, while binder handles are loose. It is raised and lowered rapidly by a double-thread coarse pitch screw, and controlled instantly by a convenient lever, arrow points indicating the proper direction.

The head is moved rapidly along the arm by hand-wheel through an angular rack and spiral rack pinion. It has a convenient clamping device for locking it in any position. Back gears are located on the head, thus bringing the greatest speed reduction direct to spindle. They may be engaged or disengaged without shock while the machine is in operation, by a most convenient lever, the high speed run being engaged through a friction.

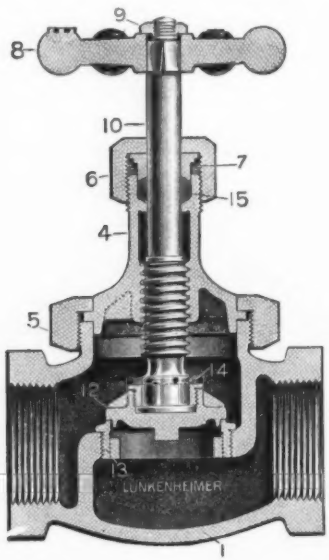
The tapping mechanism is carried on the head, between the back gears and speed box, thus giving to the frictions, already very powerful, the benefit of the back gear ratio, making unusually heavy tapping operations possible, and also permitting taps to be backed out at an accelerated speed. The lever for starting, stopping, or reversing the spindle, is controlled at the head from the front of the machine.

Renewable Seat Regrinding Valve.

THE Lunkenheimer Company, Cincinnati, Ohio, have designed the valve shown in sectional view herewith for the benefit of the trade preferring a renewable seat regrinding valve. This valve differs from the Lunkenheimer regrinding valve only in the construction of the disc and seat. The disc is provided with a protecting ring, which enters the valve seat ring. Its principal function is the preservation of the seat, which is accomplished in a two-fold manner. First, as it enters the cylindrical part of the seat it deflects the current of steam from the seat ring face, thus preventing the wire-drawing which would otherwise occur. This feature is especially important should the valve be left partly open for any length of time. Secondly, the seating surface is kept free from scale and grit by the action of the thin current of steam discharged over it as the disc is brought home. Another function of this ring is the prevention of waterhammer which is caused by the sudden admission of steam, for it will readily be seen that no matter how quickly the hand wheel

may be operated, the flange will only permit the steam to enter gradually.

The seat is renewable and can be removed from the valve body by using a flat bar to engage the lugs on the inside of the ring. The Lunkenheimer Company call particular attention to the fact that the seat may be reground a number of times before it is necessary to renew it. Not only is the seat renewable, but all of the other wearing parts, including the disc, can be renewed if necessary. The hub is securely held to the body by means of a union ring, owing to which it is impossible for the hub and the body to become corroded together, as the thread which holds the union to the body is protected at all times from the action of the steam, the joint being made be-



tween the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body, and tends to strengthen the valve. The stuffing-box can be repacked under pressure when the valve is wide open, as a shoulder on the stem directly above the threads forms a seat beneath the stuffing box. All valves above the ½ inch size have a gland follower in the stuffing box.

Confusion of the Terms "Asphalt" and "Pitch."

ANY one who has occasion to read specifications for roofing or waterproofing has probably noticed the indefinite way in which the terms "asphalt" and "pitch" are often used. Sometimes they are assumed to mean the same thing, sometimes they are regarded as alternates and sometimes asphalt will be mentioned where the context and general practice clearly indicate that coal tar pitch is meant. And this is found not only in specifications for unimportant work, prepared by men of limited experience, but occurs in the case of engineers, architects and contractors of wide reputation, engaged on large and costly undertakings. Indeed, among those who have not given this detail careful attention, the word "asphalt" seems often to carry a sort of glamour that results in its use where any material of this character is to be specified.

As a matter of fact the general term is pitch, and it includes all substances of that nature from whatever source, the dictionary definition of asphalt being "mineral pitch." Therefore, while all asphalt may be called pitch, all pitch cannot be termed asphalt. Of the kinds of asphalt pitch, or more briefly, asphalt, that can be used for waterproofing, there are barely four or five out of fifty or more varieties that are suitable for such purposes. Of the other kinds of pitch there is only one, coal tar pitch, that can be considered for such work.

As between the two, engineers who have investigated their relative waterproofing qualities are practically of one opinion, that coal tar pitch is at least as good as any asphalt. Evidence as to the correctness of this statement is being constantly furnished from old buildings where coal tar pitch has been in use twenty and thirty years and yet is chemically, mechanically and in every other respect in exactly the same condition as when first applied.

When asphalt is specified in the lax manner above described, the chances are much in favor of coal tar pitch being used, as few inspectors are capable of distinguishing between the two, and coal

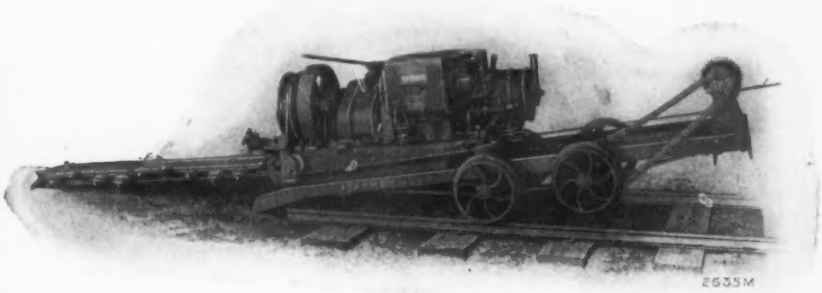
tar pitch is from 25 to 50 per cent. cheaper. Bidders who estimate in good faith on the use of asphalt find their figures too high for consideration, and to get the work must either get the specifications relaxed or, if less scrupulous, use coal tar pitch anyway, a practice that cannot well be defended.

In either case injustice is done to the reputation of coal tar pitch, as it must bear the reproach of being "something just as good" or else travel under a false name and miss the credit of its own good performance. It would be far better from both an ethical and an engineering point of view if accurate terms of specification were arrived at in the first place, and used with a proper understanding of their meaning. If asphalt is required, it should be specified by brand or place of origin, and if coal tar pitch is desired, it should be plainly specified as such.

The Jeffrey Shortwall Coal Cutter.

THE economy and speed with which coal is mined by longwall machines has given rise to a very large demand for an efficient machine operating on the longwall plan for room and pillar work. Special interest therefore attaches to the fact that the Jeffrey Manufacturing Company has added to its line of electric coal cutters a new room and pillar machine known as the Jeffrey 26-B shortwall coal cutter, an illustration of which is here shown. The difference between this and the breast machines built by that company, is largely in the method of cutting. The new type cuts across the face of the coal, starting at one side of the room and not stopping until it finishes the cut at the other side. A ½-inch steel feed cable wound upon a power driven drum at the front end of the machine pulls it across the face of the coal at a speed dependent upon and suited to the hardness of the cutting and the nature of the coal or clay in which the cutting is done. When desired, this drum can be disengaged by means of a suitable clutch, so that the machine, in finishing its cut at the left hand rib, may be angled for the purpose of maintaining a uniform width of room. Another cable having no connection whatever with the power is arranged to act as a guide to hold the machine to its work at the proper angle for its greatest cutting efficiency.

Suitable sheave wheels are provided at convenient points on the machine to guide the feed cable so that it can be led off in any direction, thereby enabling the machine to be loaded, unloaded, moved about and pulled out from under the coal by its own power,—a very desirable feature, and one which very strongly appeals to the machine runners. The gearing is arranged so that the feed drum may be operated at a sufficiently high speed to move the machine quickly about the working place. An exceptionally powerful compound wound motor is provided to take care of the heaviest service.



The operation of the machine may be briefly described as follows: It is brought

into the room on a truck moved by its own power, or hauled by a mule, depending on whether or not a self-propelling truck is used. A pipe jack is placed at the face of the coal at the right hand rib and the feed cable attached. The motor is then started and the machine moved to the face of the coal. A simple guiding device, consisting of a piece of tee rail and one jack, is then set up on the left hand side of the machine and the sumping cut started, the feed cable pulling the cutting frame in under the coal and the guiding device serving to hold the machine in line. When the sumping cut is completed, a steel anchor hook is secured by a wedge in the left hand rib near the face, to which are hooked one end of both the guide and feed cables which lead across the face of the coal. The cable is then attached to a jack set up at the right hand rib in a line with the rear drums, and the machine started across the room. In operation, the feed cable pulls the machine across the coal face and the guide cable keeps it at the proper angle to the face of the coal. A special flexible brand of wire with elliptic stranding is used for the feed and guide cables, eliminating any tendency to kink or curl up when the tension is released, and materially increasing the wearing surfaces of the cable. The elasticity of the cables equalizes the shocks and jars on the machine and gives the motor an even, steady load. When the machine reaches the left hand rib the pipe jack is moved to a position near the truck, the feed cable attached, the machine pulled out from under the coal and over to the truck where it is loaded by its own power and is ready to move to the next working place.

The motors furnished with these machines are of the most modern and improved types. The frames are made of cast steel with laminated pole pieces. The armatures are drum wound with form wound coils. The field coils are series wound, impregnated with insulating compound and enclosed in oil and moisture proof covers. The commutator bars are of the best quality of hard drawn copper, and are insulated with mica of the proper hardness to insure even wear and long life.

Turbine-Driven Fire Pumps.

THE successful test of two "Dreadnought" fireboats, the largest in the world, at New York city May 26th, demonstrated the practicability of turbine-driven centrifugal pumps in fire fighting apparatus. These new boats, the "James Duane" and the "Thomas Willett," are the first of their kind to be equipped with the new centrifugal pumps driven direct by steam turbines, and the official trial was so successful and so far in advance of the guarantees of the builders that Chief Edward F. Croker predicted that the centrifugal pump would not only take the place of the old piston pumps on fire boats but on fire engines as well.

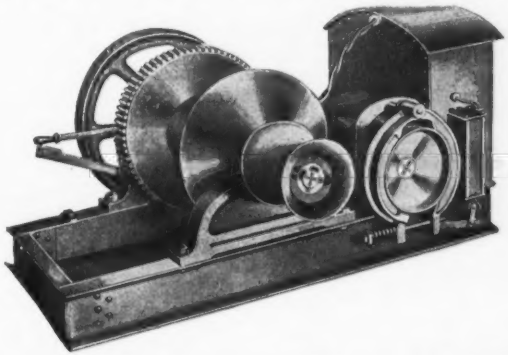
The two Worthington pumps are 12-inch, two-stage centrifugals direct connected to Curtis turbine engines. The pumps are each designed for 4,500 gallons a minute against a boiler pressure of 150 pounds, and, while only 9,000 gallons were guaranteed by the builders, more than 12,000 gallons were actually thrown, and the boat could in emergency have thrown as high as 14,000 gallons.

The Curtis turbine engines, built by the General Electric Company, which are direct connected to the centrifugal pumps, are rated at 660 horsepower but are capable of enough overload capacity to deliver 1,000 horsepower continuously. They operate a boiler pressure of 200 pounds and a vacuum of 26 inches at a speed of 1,800 r.p.m. The rotating parts of the horizontal turbines are direct connected by means of a flexible coupling to the rotating parts of the centrifugal pumps, the high speed of the turbine being sufficient to run the pumps without gears. While this method is an innovation, the trial run fully demonstrated that it is superior to the old way of pumping water with reciprocating engines geared to piston pumps. Under these conditions each turbine was tested at the rated horsepower before leaving the General Electric Company and found to deliver one horsepower at the shaft for every 15 pounds of steam. The requirements called for 9,000 gallons of

water a minute against 150 pounds pressure with a steam consumption not to exceed 10,000 pounds of steam an hour. At the actual test it was demonstrated that this amount of water could be delivered with 9,000 pounds of steam per hour.

The Grable Electric Material Hoist.

THESE machines are designed for handling building material, and are so constructed that they may be controlled from the top of the elevator shaft by the cars automatically, or in setting stone or structural steel, they may be controlled from the machine, or any part of the building, giving the operator a perfect view of the material being hoisted, thus doing away with dangerous



signals, necessary with other hoists. This machine is so constructed that it is impossible to burn it out, as the machine controls its own speed, once started, and will not allow any more current to pass through the motor than it is in position to take care of. The machine is absolutely waterproof, and cannot be damaged by dirt or weather.

One principal feature of this machine is that the brake is mounted on one end of the motor shaft, having a magnetic coil in connection with circuit with the armature, and is so constructed that when the current is applied to the machine, the brake releases, but when cut off, it clamps fully, mechanically, thereby preventing the dropping of the load.

The capacity is 600 to 3,000 lbs. on a single line, at a speed of from 75 ft. to 800 ft. per minute, the limiting factor being the power used, as the motor will increase in speed if the load is below the minimum.

This machine is built with a 12-inch drum, mounted between the main bearings; also 27½-inch sheave on one of the shafts, which may be locked to the shaft by the aid of a clutch, or may be released and held by a foot brake, while the winch head or drum are being used.

No friction clutches are necessary, as the motor is reversible, and may be reversed quicker than by friction clutch or reversing links, which are necessary on a steam hoist, and can be reversed from any part of the building.

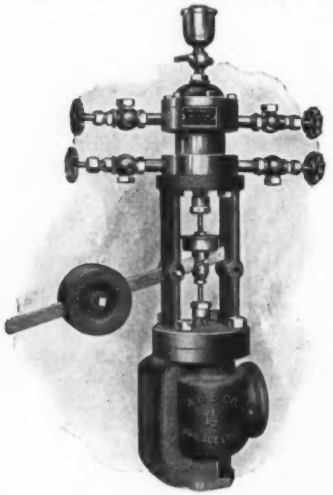
This is the smallest, most compact, and easily portable hoist on the market.

The builders are the Grable-Dunn Co., 119 Lasalle street, Chicago, Ill., who will furnish further information on request.

Copes Boiler Feed Regulator.

THE Copes boiler feed regulator and the Copes pump governor are described in a booklet just issued by the American Boiler Economy Co., of Philadelphia. The construction of this device is unique and of more than ordinary interest because of its simplicity. The longitudinal expansion of a straight composition-metal tube caused by changes of temperature furnishes the force by which a check valve in the feed line is operated. When the water in the boiler is above the desired level the disc of this valve is held to its seat by a weight acting through a toggle

joint. When the water level falls, steam enters the expansion tube and the expansion of the latter operates through a bell crank lever to raise the weight and release the check valve, permitting



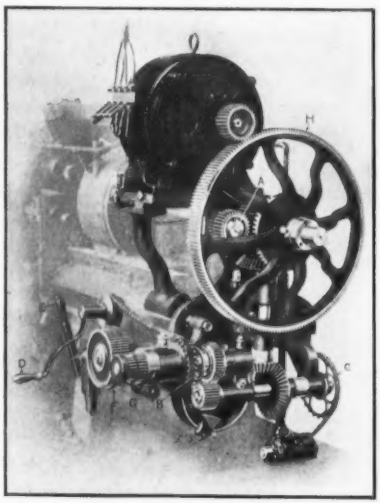
water to pass into the boiler. It is claimed that this regulator embodies only simple mechanical movements and the fireman can see at a glance just what each part is doing.

The Copes pump governor consists of a throttling valve placed in the pump steam line and controlled by a piston on the valve stem. The pressure of water from the pump discharge acts upon one side of this piston, tending to close the valve, while steam pressure from the boiler acts on the other side, tending to open the valve. A counterweight is so adjusted that the valve will just seat when the feed line pressure is at a predetermined excess over the boiler pressure. If for instance, there are three boilers in the battery and it is desired to carry a pressure, say, of 20 pounds more in the feed line than in the boilers, the controlling valve of the governor will pass steam to the pump as long as the feed line pressure is less than 20 pounds above boiler pressure. On the other hand, when the feed line pressure tends to rise above this excess, its action on top of the piston overcomes the sum of the steam pressure and the counterweight and cuts off steam from the pump until the pump discharge line pressure is reduced by some boiler taking water.

Acme Automatic Multiple Spindle Screw Machine.

THE National-Acme Manufacturing Co., Cleveland, Ohio, had on exhibit and demonstrated at the Railway Master Mechanics and Master Car Builders' Convention, at Atlantic City, June 17th and 24th, their No. 56 Acme automatic multiple spindle screw machine, equipped with motor drive. Recent improvements in this size of machine provide for single belt drive, which is readily converted into a motor drive by substituting gear "H" for pulley, and placing the motor platform and motor on the machine as shown.

The system of gearing shown is so designed that it is practically noiseless. These changes in the mechanism of the machine, make the work of operating it much lighter than formerly. The company is in a position to supply No. 56 (2¼ in.) machines equipped for single belt drive or for motor drive, with or

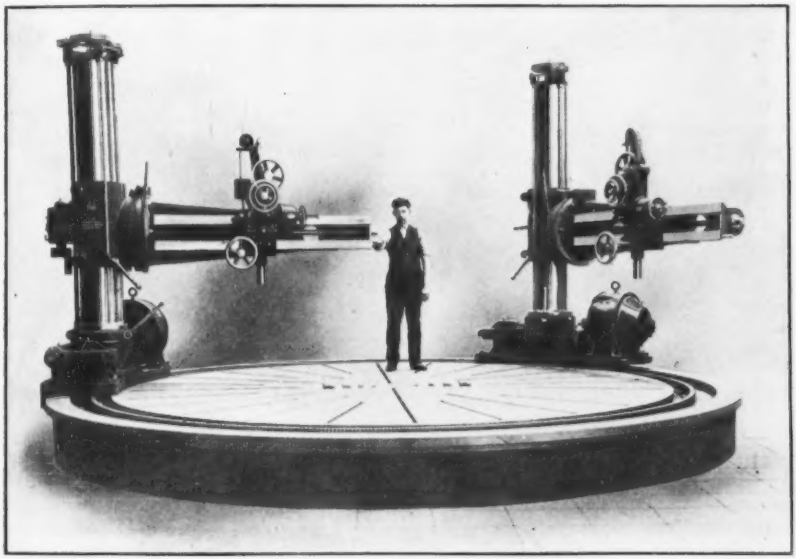


without motor. Any standard motor can be used without the slightest alteration in the motor. Where the buyer is to supply the motor, the maker's name

should be given and on A. C. motors, the phase, cycle and voltage; on D. C., voltage only. The size of the motor required varies from 3 to 5 horse power, depending upon the class of work for which the machine is to be used.

Niles Universal Radial Drill.

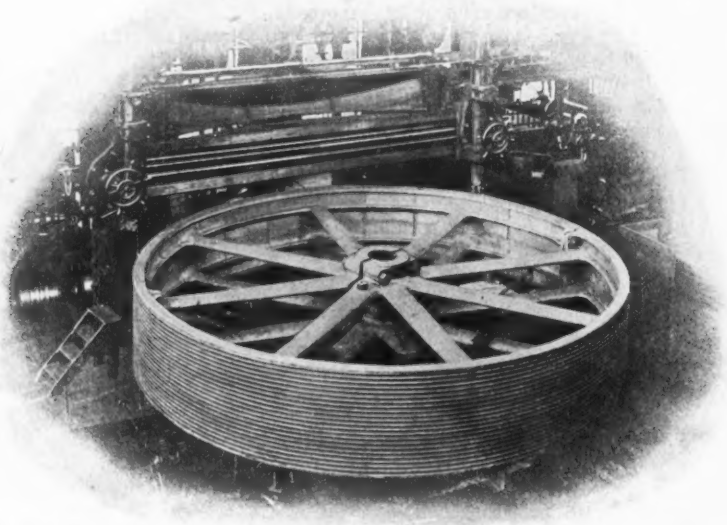
THE accompanying illustration shows a 6 foot universal radial drill, which has recently been constructed by the Niles-Bement-Pond Company for export. As will be noticed at once there are two drills mounted on a single 20 foot bed-plate and each drill is independent of the other. The power for each drill is provided by a 5 horse power Westinghouse type SA motor mounted as a part of its drill. The adoption of an interpole motor was decided upon to provide for a wide range of speed without mechanical speed changing devices. The motor selected can be varied from 400 to 1,600 revolutions per minute, and will deliver its full rated horse power for twelve hours continuous service at any speed within its range. The motor is used not only for driving the spindle, but by a special clutch may be made to move the column about the bed-plate and bring it to any desired position. Either direction of traverse may be obtained by a reversing switch, which is not shown in the illustration. The use of a variable speed interpole motor of wide range permits the drills to be run at all times at their maximum speed regardless of the size of hole to be drilled, as the speed of the motor may be varied by small steps to suit the work being done. To provide for the circular movement of the columns by mechanical drive would have been very difficult if not impossible. By the individual electric motor the difficulties are overcome in the simplest manner. As each drill column must move half way around the bed-plate, an armored cable protects the wires connecting to the motor and supplies the necessary flexibility. The controllers for starting and governing the speed are mounted one on either side of the bed-plate on a special frame, which also carries a double pole, double throw switch for reversing the direction of rotation of the motor.



A Large Rope Sheave.

THE accompanying cut shows a rope sheave of unusual dimensions recently completed by H. W. Caldwell & Son Co., Chicago, Ill. The sheave is

20 feet in diameter, has 20 grooves for 2-inch rope and weighs finished 48,000 pounds. It will be noticed from the illustration that the sheave has a double set of arms. The sheave was cast in one piece and then split for convenience in handling and erecting. The sheave was cast in the foundry of the Caldwell Company and finished on a 20-foot boring mill. It is intended for use in connection with the main drive in a refrigerating plant located in Mexico, the large sheave receiving power from an electric motor, the transmission being by means of what is generally known as the American or single rope system.



American Bridge to Cross the Nile.

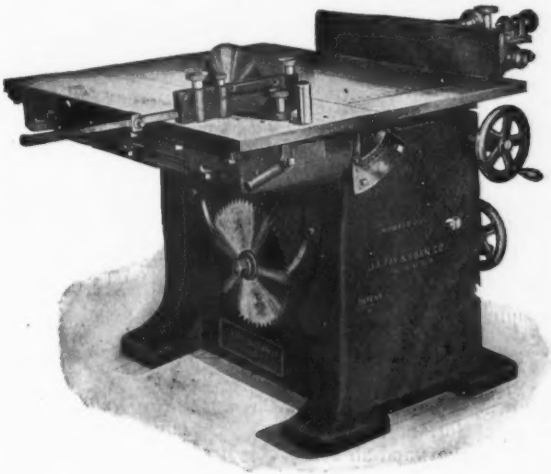
CABLE advises from Cairo, Egypt, state that the contract for the construction of a new bridge to cross the Nile at Cairo which will cost more than $1,500,000, has been let by the ministry of Public Works of the Egyptian Government to the Compagnie de Fives-Lille of France, after an international competition in bidding for its construction. The new bridge, which will be located at the deepest part of the Nile and will lead direct to the site where the Boulac museum stood, is to be built in accordance with plans prepared by the late Sir Benjamin Baker of London, the engineer of the Forth Bridge, and the Scherzer Rolling Lift Bridge Company, of Chicago, the latter company also furnishing consulting engineering services during erection. The entire work is to be executed under the charge of the Ministry of Public Works of the Egyptian Government, and it is expected that the new bridge will be completed and in service before the end of the year 1910.

This large modern bridge will be in striking contrast to some of the old types of slow moving bridges across the Nile. It has a total length between abutments of 274.5 meters. The total width of the bridge will be 18 meters, divided into two foot-paths of 3 meters each, a tramway track of 5 meters to carry double lines of electric tramway of 1 meter gauge, and 7 meters of road clearance. The structure will consist of a Scherzer rolling lift bridge with four fixed approach spans. On the Boulac side of the Nile quay walls will be constructed on masonry walls. The south end of the abutment on this side of the

river will join the existing quay wall and the north end will ultimately be joined to the quays under construction. The piers and abutments, which will be of Assouan granite, are to be built on foundations to be sunk by compressed air. The Scherzer rolling lift bridge will have a movable span of 30 meters to allow the passage of boats. In order to facilitate the heavy water and land traffic at this site, which is in the most prominent part of the Egyptian metropolis, the lift bridge is designed to operate very rapidly, the time required to open or close the bridge being less than 30 seconds. This result is accomplished by the use of the most modern electric equipment.

A Double Circular Saw.

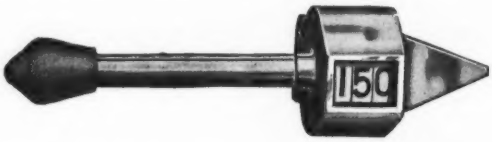
THIS is a combined ripping and cross-cutting machine, constructed on lines distinctly different from other machines of the kind. Both saw arbors are carried on a revolving frame, and it is easy to take off or put on saws without disarranging the table. Two saws up to 16-inches diameter (one on each arbor) can be carried at the same time and the frame revolved, or if only one saw is used it may be as large as 20-inch in diameter. The table is made in two sections, a moving section 44 x 16 in. moving easily on frictionless rollers, and a stationary section 44 x 20½-in. the latter having an extension so that material up to 20-in. in width can be ripped. The moving section of the table has sufficient movement to edge or cut off material up to 35 inches and will open to permit the use of a 2-inch grooving head. The whole table can be tilted by a handwheel to an angle of 45 degrees from the saw. A gage registers the angle to which the table is tilted. The ripping fence may be set to take stock up to 20 inches wide and used on either right or left section of table; a micrometer adjustment is provided on this fence, which is used when adjustments wanted are too fine to be made by hand. The miter cut-off fence is used on the sliding table and covers a range from 45 degrees back of the fence to 60 degrees in front, as shown in illustration; this is furnished with a stop-rod, to be used for stock of various lengths. This saw is one of the latest productions of the shops of the J. A. Fay & Egan Co., 212-232 West Front street, Cincinnati, Ohio.



Speed Counter.

THERE has always been a demand for a small vest pocket speed counter which is accurate and durable. The speed counter, here illustrated, is one

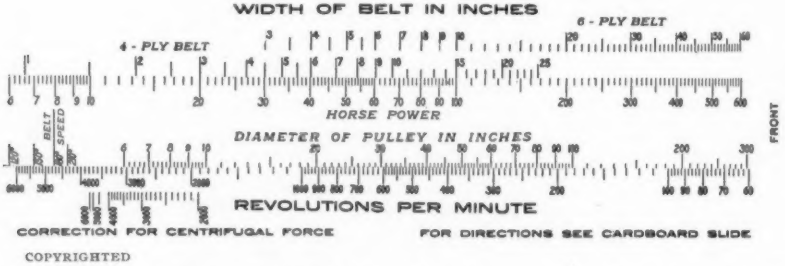
that is said to contain these qualities. The speed counter is of the same size as the illustration, being not quite three inches in length. While it is very small and convenient to carry, it is by no means fragile. It registers the exact number of revolutions, only requiring



one to take the initial reading and subtract it from the final reading to obtain the number of revolutions. This unique speed counter has been placed on the market by the American Steam Gauge & Valve Mfg. Co., 208-220 Camden street, Boston, Mass.

Belt and Shafting Computer.

A NEW belt and shafting computer has recently been put on the market by J. A. & W. Bird Co., Milk and India streets, Boston. Accompanying is



an illustration showing one side of it. The little device gives instant readings for head shaft and line shaft and all belt calculations. It is so compact it may be carried in the top pocket of the vest, and the manufacturers make a charge of but ten cents for it,—one only to a person.

—The June issue of the *Obermayer Bulletin* is replete with articles of interest to every man connected with the iron and steel trade. R. H. McDowell's article on "Some Stove Foundry Experiments" tells of his personal experien : in this branch of the foundry trade; Wilbur H. Martin gives some valuable hints on foundry management; C. Metcalf writes interestingly on pipe making; Samuel H. Fisher shows an excellent way to prevent "mudding" up oven doors; while some historical facts regarding the foundry business, together with a number of other subjects vital to the foundry trade make up a wholly enjoyable house magazine. The subscription price of the *Obermayer Bulletin* is fifty cents the year, but any of our readers may obtain a copy free of charge by writing the S. Obermayer Co., Cincinnati.

News Supplement

The Engineering Magazine—July, 1908

Personal.

—I. Willard Beam, for many years the agent of Wm. Jessop & Sons, died in San Francisco.

—William Dana Ewart, founder and former president of the Link Belt Co., died recently in Rome, Italy.

—T. F. Salter has been appointed chief engineer of the Standard Roller Bearing Co., Philadelphia.

—W. J. A. London has recently accepted the position of Chief Engineer of the Terry Steam Turbine Co., Hartford, Conn., succeeding C. E. Terry, recently deceased.

—Charles E. Lawrence has been appointed local manager of sales for the Massachusetts Fan Co., with headquarters in the Hudson Terminal Building, 50 Church Street, New York.

—J. R. McColl, formerly associate professor of steam engineering at Purdue University, Lafayette, Ind., and now connected with the engineering department of the American Blower Co., Detroit, has been delivering a series of lectures before engineering classes of the technical schools in the Middle West.

Industrial Notes.

—The Buffalo Foundry & Machine Co., Buffalo, recently established a New York office at 143 Liberty Street, with H. E. Jacoby as resident engineer and manager.

—The Chapman Ball Bearing Co., Boston, Mass., has been awarded the contract for the complete transmission equipment of the Battle Creek, Mich., shops of the Grand Trunk Railway.

—Turner Construction Co., New York, have been awarded the contract for constructing all the reinforced concrete stairs on the Manhattan approach of the Blackwell's Island Bridge.

—The R. D. Nuttall Co., Pittsburg, announces the establishment of a new department to be devoted exclusively to the manufacture of gears and pinions for air compressors.

—H. W. Caldwell & Son Co., Chicago, announce that they have opened a New England Engineering and Sales Office, Room 337, Oliver Bldg., 141 Milk St., Boston. This office is in charge of Malcolm R. White.

—Buff & Buff Mfg. Co., Boston, manufacturers of surveying instruments, report that their shops are busy again and are working practically full time. In a very short time, according to present indications, they expect to be working full time and possibly over-time.

—The Massachusetts Fan Co., Watertown, Mass., is making a large export shipment of fans to the Sutcliffe Ventilating & Drying Co., Manchester, England. This comprises six ¾-housed steel plate fans in various sizes equipped with new frictionless ball bearings.

—The offices and works of the Hadaway Electric Heating & Engineering Co., which was some time since acquired by the Westinghouse Electric & Manufacturing Co., have been removed from 238 West Broadway, New York, to the works of the Electric Company at East Pittsburg.

—The Cutter Co., Philadelphia, have offered prizes of $1,200 to the writers of essays on the use of D. C. or A. C. air-break circuit breakers. The Cutter Co. have published the conditions in booklet form and will send a copy to anyone desiring to know the conditions, awards, etc.

—The Turner Construction Co., 11 Broadway, New York, announce that they have been awarded the contracts for the construction of two reinforced concrete warehouses for the J. G. Christopher Co., Jacksonville, Fla. One building will be two stories high, 105′ x 105′ and other three stories and basement, 157′ 6″ x 110′.

—The Western Electric Co., Chicago, has recently gotten out a wall circular descriptive of the various types of Sunbeam lamps distributed by them. It will undoubtedly be found very useful by dealers, contractors and central stations to hang up for reference, as same is more convenient to refer to than catalogues.

—The Raymond Concrete Pile Co., Chicago, has been awarded its fifth contract for concrete piles at the Immigrant Station, Ellis Island, N. Y. It calls for the placing of concrete piles under two measles wards, two isolation wards and one office building for the department of commerce and labor. The contractors are the North-Eastern Construction Co., under the supervision of Alfred Brooks Fry and Frank S. Howell.

—James S. Watson, manager of the drive chain department of the Link-Belt Co., has transferred his headquarters from the Philadelphia works to the company's chain manufacturing plant at Indianapolis. In his new field he will combine supervision of manufacture with direction of the selling force handling the Renold silent and roller chains.

—Recent sales of the "Swartwout" ventilators, manufactured by The Ohio Blower Co., Cleveland, include a third order from the Richardson Paper Co., Lockland, Ohio, for seven more 36-inch and eight more 24-inch ventilators. The first order was for six 36-inch, the second for twenty-six 24-inch and seven 36-inch. This now makes a total of 54 ventilators sold to this company within a period of 90 days.

—The Faculty of the Massachusetts Institute of Technology has just conferred the degree of Master of Science on three graduate students in the Electrical Engineering Course, R. B. Anthony, who graduated from the University of Wisconsin; E. L. Moreland, who graduated from the Johns Hopkins University, and F. W. Willey, who graduated from Purdue University. Thirty-eight students, ten of whom are already graduates of Liberal Arts courses and three are graduates of the Mechanical Engineering Course of the Institute, have been granted the degree of Bachelor of Science in the Electrical Engineering Course.

—The contract for the construction of the first cyanamid plant on this side of the water has been let by the American Cyanamid Co. to Westinghouse, Church, Kerr & Co., New York. The contractors already have organized the work with men on the ground, and construction operations will be vigorously pushed in the expectation that the plant will be ready for operation in about ten months. The plant is located at Niagara Falls on the Canadian side, and for the purposes of its present and future business the company has acquired an area of twenty-six acres of land. The initial capacity of the plant will be 7,500 tons per annum, although the plans which have been prepared will permit the expansion of the industry at that point to 40,000 tons. There are eleven cyanamid plants in Europe projected, in process of construction, or in operation.

—A good example of how the development of one industry helps another is found in an order for manganese steel discs recently placed by the Cutler-Hammer Clutch Co., Milwaukee. This company makes a specialty of lifting magnets for handling pig iron and scrap metal. The growth of this business and the natural desire of the manufacturers to perfect every detail of their product has led to the adoption of manganese steel for coil shields—the coil shield being the flat disk fastened to the under side of the lifting magnet for the double purpose of protecting the magnetizing coil and interposing between the two poles of the magnet an area of non-magnetic material. Brass, which is non-magnetic, has heretofore been used for this purpose. Ordinary steel will not do because it is a magnetic metal and would serve to conduct the magnetic lines of force from pole to pole instead of compelling them to seek a passage through the material to be lifted. Manganese steel seems to be the ideal metal for this purpose. It is non-magnetic, like brass, and infinitely harder—so hard, in fact, that the continued hammering of the pig iron or other metal on the under surface of the magnet makes not the slightest impression on it. The 50-inch magnets recently furnished by the Cutler-Hammer Clutch Co. to a number of steel mills in the Pittsburg district are all equipped with manganese steel coil shields instead of with the brass coil shields formerly used.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

Chimneys.

H. R. HEINICKE, INC., 147 Fourth Ave., New York—Catalogue illustrating and describing factory chimneys of the hollow radial brick type. Also contains many views of chimneys recently erected. 5½ by 8½ in.; pp. 72.

Conveying Machinery.

LINK CHAIN BELT CO., 52 Dey St., New York—Catalogue No. 20 treats of elevating, conveying and power transmitting machinery, and is illustrated with views showing actual installations. Also contains tables giving prices, dimensions, etc. Fully indexed. 6 by 9 in.; pp. 208.

Dynamo Brushes.

CUTLER-HAMMER MFG. CO., Milwaukee—Pamphlet descriptive of "Wirt Type" dynamo brushes designed for use with low tension direct current motors and generators, alternating current generators, plating dynamos, exciters, etc. The construction of the brush is fully described and illustrated. 3½ by 6 in.; pp. 16.

Feed Water Heaters.

BATES MACHINE CO., Joliet, Ill.—Well-printed catalogue devoted to an illustrated description of the Cookson combination feed water heater, purifier, filter and oil separator. 6 by 9 in.; pp. 64.

Fire Tube Boilers.

SAMUEL SMITH & SON CO., Paterson, N. J.—Booklet giving a partial list of users of their boilers. Illustrated. 3½ by 6 in.; pp. 8.

Generating Sets.

B. F. STURTEVANT CO., Hyde Park, Mass.—Bulletin No. 156 is devoted to an illustrated description of generating sets with vertical compound engines. 6½ by 9 in.; pp. 8.

Graphite Lubricators.

GRAPHOIL LUBRICATOR CO., 49 Clymer St., Brooklyn—Catalogue illustrating and describing graphite and oil lubricators and graphite cups for cylinders of stationary and locomotive steam engines, gas or gasoline engines, air compressors or vacuum pumps, bearings, etc., together with prices. 5 by 7 in.; pp. 12.

Milling Machines.

GARVIN MACHINE CO., Spring & Varick Sts., New York—Catalogue C illustrates and describes knee type, universal, plain, constant drive, vertical, hand and motor drive milling machines. Also contains tables giving dimensions. 6 by 9 in.; pp. 96.

Portland Cement.

UNIVERSAL PORTLAND CEMENT CO., The Rookery, Chicago—Bulletins Nos. 46, 47, 48 and 49 illustrate, and briefly describe, a number of structures on which this cement was used. 6 by 9 in.; pp. 8.

Power Transmission Machinery.

T. B. WOOD'S SONS CO., Chambersburg, Pa.—Abridged catalogue No. 24 illustrates and describes, together with tables giving sizes, prices, etc., modern and approved appliances for the transmission of power. 6 by 9 in.; pp. 62.

Railway Motor Car.

STRANG GAS-ELECTRIC CAR CO., 15 Wall St., New York—Bulletin devoted to an illustrated description of gas-electric railway motor cars. Also contains views showing motor cars in practical operation. 8½ by 11 in.; pp. 18.

Smoke Preventer.

CLIMAX SMOKE PREVENTER CO., Equitable Bldg., Boston—Catalogue containing an illustrated description of smoke preventers, together with a partial list of the plants equipped with this device. 6 by 9 in.; pp. 16.

Steam Hammers.

BUFFALO FOUNDRY & MACHINE CO., Buffalo—Bulletin No. 804 contains a brief illustrated description of Bell steam hammers, together with tables giving sizes and dimensions. 8½ by 11 in.; pp. 4.

Steel Lockers.

DURAND-STEEL LOCKER CO., American Trust Bldg., Chicago—Booklet containing a well-illustrated description of steel lockers and wardrobes. 4¼ by 7½ in.; pp. 30.

Tanks.

W. E. CALDWELL CO., Louisville—1908 catalogue illustrates and describes wood tanks of all sizes and kinds, together with tables giving dimensions, capacities, prices, etc. 6 by 9 in.; pp. 36.

Traveling Cranes.

ALFRED BOX & CO., Philadelphia—Well-printed catalogue illustrating and describing electric traveling and jib cranes, together with a list of some recent installations and views of the same. 9¾ by 6¾ in.: pp. 48.

Tube Cleaners.

LAGONDA MFG. CO., Springfield, O.—Catalogue G illustrating and describing Weinland turbine boiler tube cleaners. Also contains many testimonial letters. 7 by 5 in.; pp. 36.

Ventilating Fans.

MASSACHUSETTS FAN CO., Watertown, Mass.—Booklet illustrating and describing Davidson electric fans that can be equipped with any of the standard motors for direct or alternating current. 3½ by 6¼ in.; pp. 16.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

SITUATIONS WANTED

ARE YOU making the money you should be? Do you know where the weak spots are? Why not get a works manager or superintendent who has had experience hunting out these weak places and applying the proper remedy? Experienced and practical manager of men can accept position on short notice. Can show past records which speak for themselves. If interested, look me up and see what past employers think of me. Will accept position anywhere with chances of betterment, with concern of good standing, in return for results. Address Box 121, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York.

ENGINEER-SALESMAN:—Young man, at present employed, good experience, and capable. Well acquainted with manufacturing and building trades in New England. Wants a line of machinery or power equipment on commission or salary and commission. Correspondence invited. Address Box 122, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York.

A SITUATION as Works Manager or General Superintendent by a high grade executive and mechanic. What is desired is a situation with some company where the production is not satisfactory, either quantity or quality; where the systems in use are not giving the desired results; where piece work or premium systems have been too costly or have proved a failure; or where manual labor has or is the cause of trouble through lack of discipline or lack of interest due to misunderstanding. Will undertake the reorganization of an old plant or the installation of new. The class of business desired is the manufacture of medium or heavy mechanical goods or machinery of any value. The salary to be the minimum until ability and worth have been proven, but success must be rewarded by admittance to the company, a membership in the board of directors or increased salary. My present location is Massachusetts, but I am willing to change. American birth, 38 years of age, temperate, of good health, habits and character. Can give any class of references required. At present employed, but can retire from present situation at any time. Address Box 116, care THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York. 2-6

BOOKS

THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guess-work; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

EVERY PRACTICAL ENGINEER should compile his own note book. Subscribe for Webber's tables, printed on 4x7" sheets, for insert binders. Every engineering subject, 25 cts. per sheet, printed on both sides. Write for information to WILLIAM O. WEBBER, Consulting Engineer, 432 Exchange Building, Boston, Mass. 12-8

THE ENGINEERNG INDEX ANNUAL for 1907 embraces all branches of engineering, and clearly indexes alphabetically by subject about 9,000 important articles of permanent value which appeared during 1907 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 450 pages, 9½ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

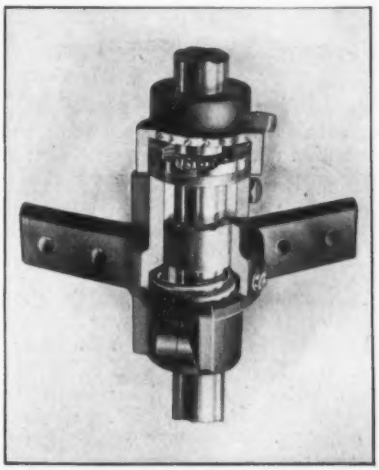
IMPROVED MACHINERY

New Processes and Appliances

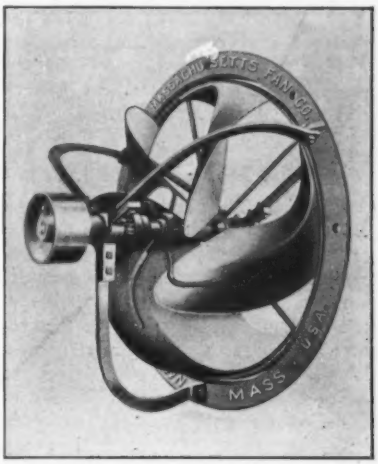
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Thrust Bearings on Fans.

IN the design of fans of the propeller type it appears that the effect of the end thrust on the shaft is frequently overlooked. In ordinary construction no provision whatever is made to remove this source of friction or reduce its effect. The pressure of the air against the fan blades due to their speed produces a lengthwise push on the shaft which would displace the fan wheel if means were not provided to prevent it. Although the unit pressure per square inch upon the face of the fan is relatively slight, the aggregate over the entire area is sufficient to warrant consideration, for its intensity per unit of area is vastly increased when it is all concentrated upon the surfaces like a collar and the bearing end which rub together as the end push is resisted. In the design of the Davidson ventilating fans, manufactured by the Massachusetts Fan Co., Watertown, Mass., this subject has been



given the consideration which it deserves. The result is a ball thrust bearing which practically eliminates the entire thrust friction. It consists of a series of hardened steel balls carried in a brass ring between two hardened steel



rings of similar shape, all being loose on the shaft. The main portion of the cast iron bearing, to which the supporting arms are bolted, bears against one steel ring which remains stationary. The other turns with the thrust collar which is fast on the shaft and encloses the three rings. The balls bear on the inside faces of the two steel rings, while the brass ring containing them is perfectly free to turn between the steel rings. There is no possibility of rusting in place. The main bearing lining is of the best quality babbitt metal. The whole is constantly lubricated by a ring oiler dipping into a large oil reservoir cored in the lower half of the bearing.

The frame consists of both wrought and cast iron parts carefully machined, fitted and bolted together in the most rigid manner. Each of the bearings is connected to a heavy cast iron wall ring by three heavy wrought iron braces. For vertical shaft driving Davidson fans

are fitted with special extra large adjustable lower or thrust bearings, made up of hardened steel discs running in a bath of oil. The entire weight of the fan and shaft is carried by this bearing. The upper or guide bearing is of the ball and socket type, lined with a removable graphite bushing which requires no attention or lubrication. In all other respects the vertical fans are identical with those of the horizontal type.

To provide for various conditions and individual preferences, Davidson fans are also regularly furnished with any one of the different standard motors, direct current or alternating.

The Fountain Trowel.

AN increasing number of problems has arisen in connection with brickwork within the past few years, due largely to the encroachments of concrete upon the field of the older art. Brickwork has suffered far more in this respect than has any other structural method. The recognition of this fact has aroused the advocates of brickwork to unusual efforts in the attempt to preserve bricklaying from the gradual decay which seems imminent. One of the first to become interested in this work was Frank B. Gilbreth, the New York contractor. The fact that he has executed contracts in many parts of the United States and Canada has enabled him to approach the task with more than ordinary appreciation of the obstacles to be overcome. Through practical knowledge of the positions assumed by the bricklayer in placing a single brick in position, and a careful dissection of the motions involved, Mr. Gilbreth became convinced that the same result could be obtained with the elimination of much unnecessary movement and a consequent shortening of time. The fountain trowel, which has been in practical use by the bricklaying department of the Gilbreth organization for some time, furnishes an excellent example of the way in which the theories of Mr. Gilbreth find application.

The fountain trowel consists of a metal can, shaped something like an oxford shoe. The heel is used to scoop up mortar from the mortar box while the toe has an opening the entire width of the can, through which the mortar is poured upon the bricks. This device makes it possible to spread a far greater quantity of mortar within a given time than is possible with the more familiar type of hand trowel. At the same time it permits the bricklayer to use mortar sufficiently soft to fill the joints better, not only because the mortar runs down into the unfilled joints of the course below, but also because it permits the shoving of the joints full of mortar in the course that is being laid.

Contrary to the expectations of people unfamiliar with labor conditions, bricklayers and laborers have shown great interest in the fountain trowel, realizing that in it and like improvements lies the possibility of future prosperity for the bricklaying craft. The bricklayer realizes that the betterment of implements will enable him to produce a much greater day's work with the same effort. This means both increased wages and lessening of production costs. Successful effort toward such an end is understood by intelligent trade unions of to-day to be the greatest factor in the prosperity of any particular class of craftsmen.

The Correct Way to Apply Detachable Chain.

IN running chain-drives, the drive should be considered as a whole, and the action noted at four points, viz.: *a*, entering point on the DriveR; *b*, releasing point on the DriveR; *c*, entering point on the DriveN; *d*, releasing point on the DriveN; shown by *a*, *b*, *c*, *d*, in Fig. 1.

Action at a point is said to be good when all the articulation or bending takes place in the joint of the chain; Fig. 2. The action is said to be bad when, in bending, the link rubs on the sprocket, producing wear on the sprocket and outside or external wear on the hook; Fig. 3.

Another fact: there is never more than one tooth in action at any one time; no matter how carefully the chain and

sprocket may be made. As soon as the load comes on, there is a change caused by stretch and wear.

We can pre-determine which tooth shall be in action by making the pitch of the wheel either larger or smaller than the pitch of the chain. Thus, on the DriveR (Fig. 4), the wheel pitch being smaller than the chain pitch, the entering tooth does all the work. In Fig. 5 the conditions are reversed: the wheel pitch

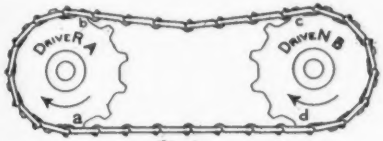


Fig 1.

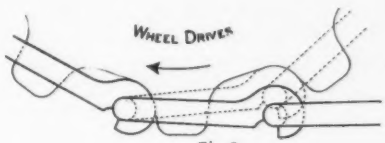


Fig 2

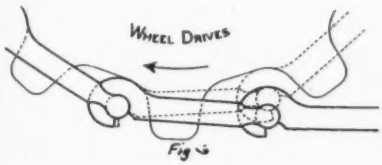


Fig 3

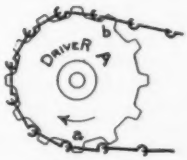


Fig 4

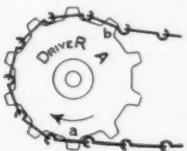


Fig 5

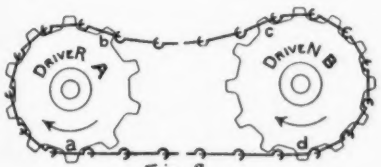


Fig 8

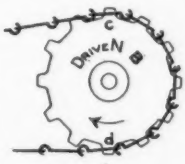


Fig 6

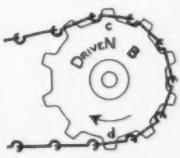


Fig 7

is the larger and the releasing tooth does the work. On the DriveN the same thing holds, except that here, too, conditions are reversed.

When the wheel pitch is smaller than the chain pitch the releasing tooth does the work; Fig. 6. When the wheel pitch is larger than the chain pitch the entering tooth does all the work; Fig. 7.

For the best work the pitch of the DriveR should be larger than the pitch of the chain, as in Fig. 5, and the pitch of the DriveN should be smaller than that of the chain, as in Fig. 6. The releasing teeth, *b* and *d*, are therefore, the working teeth and the chain can seat at *a* and *c* quietly and take the load gradually as the wheel revolves.

Having considered the question of wheels, now regard the drive as a whole to determine whether the chain shall be run Bar first or Hook first.

In Fig. 8 we have the DriveR large, the DriveN small; hence *b* and *d* are the teeth in action. Chain runs bar first: action at *a* good, at *b* bad; at *c* good, at *d* bad.

With the same sprockets, but running the chain hook first, the action at *a* will be bad, but the fact that the hook is not in contact with a tooth face at this point makes the consequent wear of little extent. The action at *b* will be good; at *c* bad, but this is on the slack side of the chain and causes no wear. Action at *d* good.

It is thus seen that there are two very bad points (*b* and *d*) where the chain runs bar first and only one serious trouble (*a*) when running hook first. Therefore, run hook first.

Take a drive with sprockets such as are usually furnished: these are ground

to fit the new chain; when the latter stretches, both DriveR and DriveN are small as compared to it, which brings teeth *a* and *d* into action.

With such a pair of wheels and with the chain running bar first, the action at *a* will be good; at *b* bad, but as there is no tension on the chain at this point, this is not objectionable. At *c* action will be good; at *d* bad. Therefore, it would seem that wear would be confined to the DriveN wheel. This is so in actual practice.

With same wheels and chain running hook first, the action at *a* will be bad; at

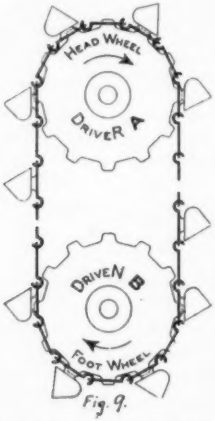


Fig. 9.

b good; at *c* bad, but not objectionable, because, as before, there is no tension at this point; action at *d* will be good: all the wear would seem to be on the DriveR as a result of the action at *a*. This is found to be the case; hence both theory and practice show that with the chain running bar first DriveN wheel wears, with chain running hook first DriveR wheel wears.

Because the wear at *d*, running bar first, is caused by the link slipping up the tooth it tends to undercut and form a hook and thus break the chain. On the other hand, the wear at *a*, when running hook first, is caused by the link slipping down the tooth, and the wheel will wear out completely without endangering the chain. It has also been proved that the DriveR, running hook first, lasts several times as long as the DriveN wheel when running bar first. As the DriveN wheel is in nearly every case much larger than the DriveR and the consequent wear on each tooth is less, it would seem that if the chain were run so as to wear the DriveN, the wear on the two wheels would be equalized. This would be poor practice for the reason that the DriveR, being smaller, is more cheaply replaced, and the repair account will, therefore, be less running hook first.

In elevators, Fig. 9, the head wheel acts as a DriveR, the foot wheel simply as an idler, because it is doing no work. Therefore, run the chain bar first so as to favor the DriveR. On conveyors one wheel is always an idler, comparatively speaking, and the same reasoning holds as for elevators: the chain should run bar first in all cases. In general, therefore, on drives run hook first; on elevators and conveyors run bar first.

The foregoing remarks apply to all closed-end pin chains: the closed end corresponds to the hook and the pin end to the bar of the detachable chains.

Reilly Feed Water Heater.

THE steel shells of the Reilly feed water heaters and evaporators present many difficulties to the flanging gang. The door openings of these heaters are formed by flanging out the shell sheet of the heater, and as the sizes of the heaters have varied to such an extent that the use of hydraulic forging process was not allowable, it is necessary to depend entirely upon the skill of the flanger in producing these shells. A narrow slot is first cut in the shell sheet some two-thirds the length of the intended door opening, but only two or three inches wide. The sheet is then heated around the opening and the metal swaged at both ends and thickened, while the opening is enlarged, until the door opening of the proper size is formed, with a nozzle projecting directly out at right angles to the axis of the shell. The edge of this nozzle is then trimmed with a chisel to a smooth surface, and a reinforcing ring of steel angle is riveted around the opening, to the flange of which the door can be bolted.

A simpler construction has recently been developed, but still presenting many difficulties to the flanger. This consists in drawing out the door opening and door frame without the use of reinforcing angle, the flange of the opening being turned in instead of out. A cast iron former is used for this construction, giving the flangers a fixed shape to work

against in forming the metal around the opening.

The Reilly feed water heaters and evaporators have been used for many years on ocean-going vessels of all sizes, and their use has recently been extended to stationary plants on land. Among the many advantages of heating feed water for boilers is the avoidance of strains from unequal heating and cooling of the boiler shell, but at the expense of the feed water heater itself, whose straight tubes were strained and loosened by the cold water passing unequally through them.

The tubes of the Reilly apparatus are seamless drawn copper tube, wound spirally upon a mandrel and secured to manifolds by ground union joints. These tubes cannot be strained by unequal expansion and contraction, and the construction is one of the most durable possible, beside being extremely efficient in use. The heating effect of a Reilly heater is usually within two or three degrees of the temperature of the exhaust steam, and therefore very much better than the usual results secured from straight tube heaters.

Coal Tar Pitch Filler.

THE subject of bituminous fillers for the joints in brick and block stone paving is receiving considerable attention in the trade papers, the articles appearing in behalf of so-called oil asphalts. Some of these articles create an entirely erroneous idea as to the qualities necessary and the advantages of bituminous fillers.

To give satisfaction a filler must, first of all, bind the bricks or blocks tightly together so as to give a continuous water-proof surface that will prevent water from passing through to the foundations. It must also take care of the expansion and contraction of the blocks themselves incident to changes in temperature. The question of protecting the top edges of the bricks or blocks is only incidental, as there is comparatively little wear at these points where a good quality of brick or stone is used, and that little is a great aid to traffic, as it gives the horses a proper footing.

One of the greatest objections to a grout filler is that it makes a continuous, slippery, hard surface and this is particularly noticeable on streets having an appreciable grade. A grout filler is also very rigid and does not allow for any expansion or contraction of the pavement, with the result that it soon bulges or cracks, leaving permanent openings

through which water penetrates to the foundation.

Theoretically, expansion joints of bituminous material provide for expansion and contraction, but in practice cracks frequently occur, and bulging is not uncommon where expansion joints are used. The perfect filler is one that permits all blocks to be set as close together as the lugs or letters will permit, that provides in each joint for the expansion or contraction that may take place in each block, that permits each block to rest entirely on the foundation, that provides a perfectly water-tight pavement at all times of the year and that gives just sufficient roughness to the surface so that horses get a footing.

It is maintained by many that the only filler that will provide all these conditions is a bituminous filler and the only one that fulfills all the conditions perfectly, is a straight run coal tar pitch having a melting point varying not more than 5 degrees either way from 135 degrees. Coal tar pitch is not only the best but the cheapest. It adheres perfectly to brick, stone or concrete (curb or gutter) even when applied under unfavorable weather conditions and bonds the bricks firmly together. Any possible break or joint is only temporary, as on the first warm day the pitch filler closes up as tightly as before. A safe footing is provided for horses, there are no cracks in the pavement and no rumbling hollow sounds because of sections raising from the foundation.

Pitch filler also permits of immediate use of pavement instead of being blocked up for eight to fifteen days, as in the case of grout filler. In the higher melting points made so much of by promoters of oil-asphalt fillers, lies their greatest weakness. To obtain these melting points the oil-asphalt is distilled so far that it loses practically all its strength and in a short time becomes "dead" and crumbly; it therefore will not bind the bricks or blocks firmly together except when applied under ideal conditions, which are seldom or never obtained in practice If there is any moisture in the brick or block the hot asphalt brings it to the surface and forms a film between the brick itself and the filler, which prevents adhesion. Also on account of this high melting point, an asphalt filler has to be heated and applied very hot, and as it chills quickly on the bricks it frequently fails to run to the bottom of the joints.

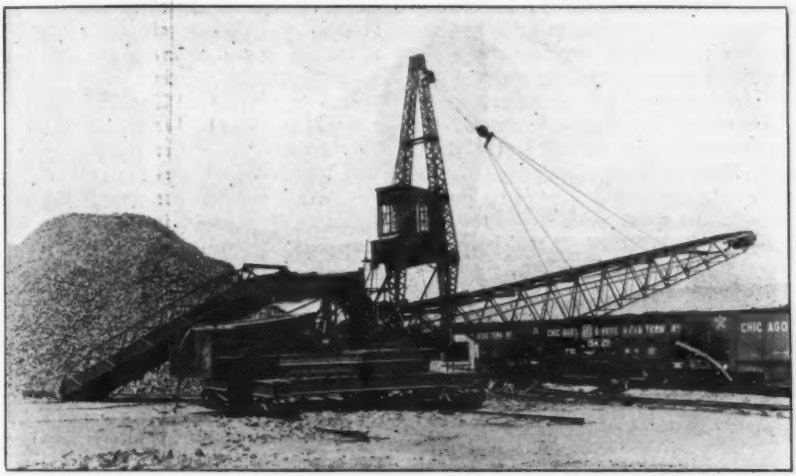
Unless a tight joint is made at the time of application the asphalt filler will never adhere to the brick, as the maximum temperature of the pavement in summer will not reach the point where asphalt becomes sticky. As evidence of this fact, it is a matter of common knowledge among contractors for brick pavements that in removing sections where such a filler has been used the filler can be thrown into one pile and the bricks into another. The nature of the oil-asphalt filler is such that it compresses readily as the bricks expand, but as the bricks contract the asphalt does not settle and expand accordingly.

It is common knowledge that a more sticky material is required to adhere properly to stone or concrete curb than to bricks or block, and as most of the moisture develops in the gutters next to the curb it is particularly necessary, where expansion joints only are used, to have a material that will insure a water-tight pavement at this point.

Storage Reserve for South Works and Gary.

ONE of the most interesting engineering developments of the past twenty-five years has been systems and devices for handling and re-handling loose materials. The storage principal has been continually expanding in all these years, and manufacturers and inventors have vied in developing plants that would cut down the cost of stocking and re-claiming all materials that railroads carry in bulk. The maximum handling capacity is secured by devices employing the continuous conveying system. On the other hand the traction machines, such as grab buckets in connection with locomotive crane, have an elasticity that gives them greater scope than the conveying plants which heretofore have been stationary.

The photograph shows a new type of storage machine loading coke from one end of the Illinois Steel Company's yard at Stockton, Indiana. This yard acts as a reserve for Gary and South Works. The coke pile is 35 feet high. The company has stored on the 100 foot wide platform some 100,000 tons of coke, which this machine is handling. In one day's run, 4¾ hours' time, there were loaded 24 steel hopper bottom cars, containing in all 732 tons of coke. Three men operated the machine at a cost of $7.00 a day for wages, which would make the cost per ton for loading less than one cent.



HAMILTON STORAGE MACHINE AT END OF COKE STORAGE PILE FOR SOUTH WORKS AND GARY.

The cost of loading this material by hand (which previously was done in order to prevent breakage) is 19 cents a ton. The machine consumed an average of 20 H. P., which may be counted at 30 cents an hour. Adding this to the labor cost gives a total actual cost of a cent and a half a ton for the coke loaded. This means a saving over hand loading of over $100.00 on the day referred to. This is exclusive of charge for depreciation.

Aside from this the machine delivers the coke into the car in very much better condition than is done even by hand loading, and it is estimated that a saving of probably 5 per cent. will be made on this point alone. Coke on the yard costs about $5.00 a ton, and counting this saving at 20 cents a ton, the machine is handling the 100,000 tons, will more than save its cost in a year's time.

The machine is really a moving system of conveyors, and the constant stream it delivers accounts for its great capacity. It is operated on its own track by its own power. The gathering conveyor is mounted to swing universally about the head shaft, its nose continually resting upon the platform, so that the scraper conveyor is able to pick up material from any part of a 100 foot wide platform.

The material thus carried up is delivered to a second conveyor, which swings about the head shaft on a turn table. It will deliver the material into cars at either side of the platform, or, in fact, at any point that may be desired, within its radius. As the latter conveyor may be raised and lowered, it will stock material up to a height of 35 feet.

The machine handles material both into and out of storage at the rate of four to six tons of bituminous coal per minute. And as the speed of the gathering conveyor is very low, it accomplishes this without damaging the material.

The first cost is 25 per cent. of the cost of a traveling bridge and it will have four times the capacity of a loco-

motive crane and grab bucket, at the same time handling the material without breakage.

The argument as to breakage applies equally to stocking the coal on the yard, for the machine also does this part of the work. The coke is dumped on a platform from hopper bottom cars, which are located on the trestle, the nose of the machine being swung underneath the trestle; the delivery conveyor stocking the coal at the apex of the pile, which may be as high as 40 feet where desired.

The machine delivers the coke to the pile without any drop, as the delivery conveyor may be raised or lowered to suit the height of the pile. When the pile has reached the desired height the machine moves by its own power a few feet further down the platform.

Among the other points claimed for the machine, which is built by the Hamilton Manufacturing Company, of Columbus, Ohio, is that there is no investment in the plant aside from the machine itself, the track on which it runs and the trestle at the side of the yard. When additional storage is called for, the extension of the track and trestle is all that is required; for the machine moves as it builds or reloads the pile all along the length of the platform. In other words, the machine has the elasticity of a locomotive crane and the capactiy of a traveling bridge, without the limitations of either.

The excessive cost of installing any of the well known storage systems has limited their use by railroads as well as wholesale users and distributers of coal. The application of a portable system of conveyors to this purpose brings the first cost of such a plant down to a point where true economy both in time and money will follow the adoption and further extension of the practice of storing coal.

This system differs from all others in that one machine both stocks the material and re-handles it into the railway cars from the storage pile. Its first cost is low and its storage capacity is only limited by the length of the yard.

The machine is self-contained and requires no overhead structural work as in the case of any bridge and grab bucket arrangement. It can also operate on any platform fitted with a track of its gauge. These machines handle coal continuously at the rate of five tons per minute. The low cost as well as the high efficiency of this portable loading machine will enable railway companies and other users and distributors of coal to equip yards from which coal can be withdrawn as needed, promptly and at a trifling cost per ton.

In case of the railway coal can be hauled and put into storage during the months when there is a surplus of coal cars. The actual cost of re-handling the material will be more than offset by the advantage gained in having the coal near its destination at the time when the rush orders for coal come. The coal car mileage will be reduced to a minimum in the busy season. A smaller number of cars will take care of the business during this period and the dangers of the coal famine will be avoided without any material increase in the number of cars required for the normal running of this branch of freight traffic.

By adopting this flexible storage system at different points along the line, the coal traffic will be kept more uniform and the general commercial service will be greatly improved, and the railway company will have a supply on hand for their own use. The coal operators will be benefited in that they can keep their mines running in the dull season to supply the certain demand of the early winter.

A smaller machine for minor distributing points, for gas plants, electric plants and other coal users is also built. It costs about 20 cents a ton to load coal and coke out of storage by hand labor. The machine will save at least 15 cents on every ton it handles. But important as this direct saving is, the larger advantage will come with the certainty of having an adequate supply of fuel for sale or for use, at all times. As this fuel would naturally be purchased in the slack season, the charge for re-handling, will, in most cases, be more than offset by the saving in the first cost of the coal.

An interesting point that developed in

connection with the installation is the fact that it is found to be cheaper to run coke into storage than to use the rolling stock for storage purposes. It is impossible in a large plant to have the supply of coke come in evenly and it is customary to count on carrying a reserve sufficient for several days' run on the the track in the costly steel car equipment.

A plant requiring 100 cars of coke a day will have 500 to 1,000 cars on sidings. These cars represent an investment of from $500,000 to $1,000,000.

With this installation, the excess that comes in above a safe amount, say enough for one or two days' run, will go direct into storage. This will give the company from 300 to 500 more cars, thus saving an investment of from $300,000 to $500,000.

It costs less than $1.00 a car to put the coke into storage and to reload it; and it costs $1.00 a day to carry the cars on the siding. A car that stays on the yards for five days costs $5.00. The machine will save $4.00 on every car so handled.

Of course, this does not appeal to the company that does not own its cars, but it is a saving to someone—either to the company or to the railway, and their interests are mutual.

With a low priced, efficient machine on the market, the storage of coal at the mines, as well as the yards, will shortly become general. At present very few coal mines are equipped with storage facilities, and those that are have a capacity of perhaps 500 or 1,000 tons, usually in bins, a very costly form of storage. Commonly the coal is brought directly into the railway cars. When there are no railway cars at hand, the mine shuts down. It can be safely said that the mines of the United States are shut down 25 per cent. of the time on this account, as it is impossible for railways to deliver as needed the exact proportion of cars that every mine should have. It is proposed to install these storage machines at the pit mouth, to load the coal directly into the cars when there are cars at hand, and to run the product of the mine into storage when cars are not at hand. This can be done for one cent a ton, without damaging the material, and the saving effected through the continuous running of the mine will greatly exceed the cost.

Another reason that exists for storage of coal and coke at coal mines is that the demand for both of these commodities is bound to be irregular. The mine that has 10,000 tons of coal in storage, which can be loaded out by the train load at the rate of five tons a minute, will get orders that those lacking these facilities would lose. The operator, in other words, will be able to load cars when he gets them. And this is another point in favor of the storage at mines, for at times the railway company can deliver more cars than are needed, and these the operator can fill at his discretion, without increasing the cost of his product more than one cent a ton.

It is the intention to place run of mine coal into storage, but in loading it out the machine will deliver any size of coal that may be desired, as it is provided with screens that will properly clean the coal.

The installation, such as we have above outlined, will enable the mine owner to run his mine to its full capacity all the time. When his orders for coal exceed his current mining capacity he will have the reserve of storage to draw from.

Not only will the operator benefit by this storage, but the railway companies, as well as the latter will be relieved of the necessity of providing a uniform number of cars to their clients. These cars will be loaded much more rapidly and the supply of coal will be made much more continuous and regular.

Motor Driven Cold Metal Saw.

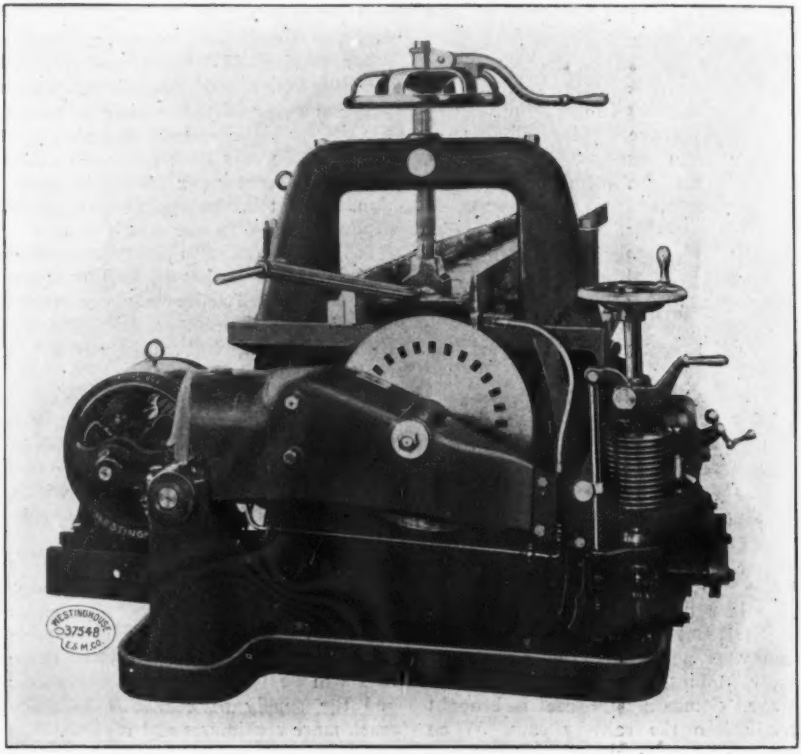
THE use of small cold saws for cutting off all sizes and shapes of metal work has become very general in a great variety of establishments, not only because of the utility of the saw itself, but also because of the fact that individual motors have been most successfully fitted to the saws.

In a great many establishments it

would be almost impossible to place the saw so that it could be conveniently used by the workmen. In the average machine shop one or more saws are required in the stock room or some other equally inconvenient place for mechanical drive. Here the use of a small motor on the saw permits the location to be selected without reference to any requirements except the convenience of putting work through.

ment Company of New York City, and is fitted with a Westinghouse shunt motor. The size shown requires a 2½ H. P. motor and is capable of cutting 8 inch round stock. A Morse silent chain is used to connect the motor to the saw, in preference to gearing, as experiments have shown the former to be more satisfactory.

It is necessary to be able to adjust the speed of the saw in order to cut differ-



In structural iron works the self-contained unit of motor and saw can be picked up by a crane and carried to any part of the building or yard. Similarly the use of the motor driven set is found very advantageous in a great many plants.

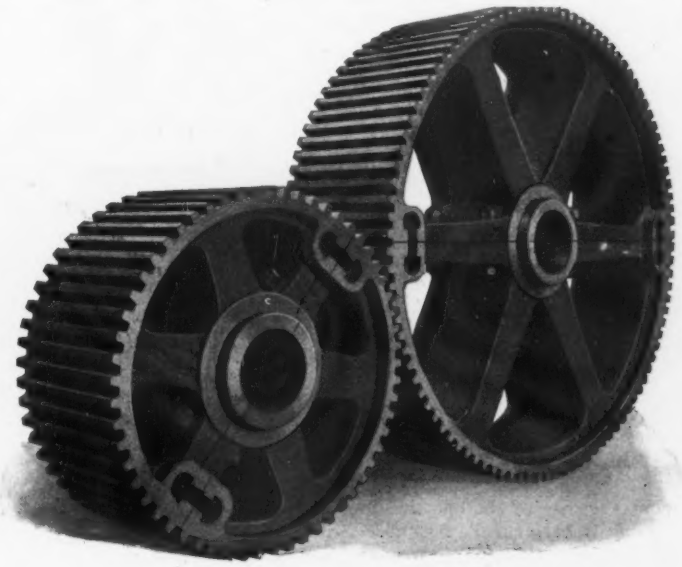
The cold saw illustrated, which is one that does not require a bevel gear, is especially adapted to motor drive. The saw is manufactured by the Lea Equip-

ent metals with maximum efficiency. For instance, experiment has shown that the peripheral speed of the saw should be 52 feet per minute with a very coarse feed for structural iron, machinery steel and metals of this class. For annealed tool steel a lower speed of but 37 feet a minute is the most efficient. The same speed is also used on Krupp's chrome nickel steel. In order to obtain these speeds, an adjustable speed motor with

speed range of 1⅓ to 1 is used, with a speed controlling rheostat. It is only necessary to move the handle of the controller to obtain any desired speed.

Large Cut Gears.

THE illustration shows a cut gear and pinion recently produced by the shops of H. W. Caldwell & Son Co., Chicago, Ill. The gears are of a semi-steel mixture and the weight of the large gear is 13,800 pounds and of the small gear 8,000 pounds. The diameter of the large



gear is 95.51 inches and of the pinion 55.41 inches. Width of face 27 inches, pitch 3 inches.

The gears were cast in halves and the joints planed. The dimensions of the gears are unusual on account of the small pitch as compared with the wide face. The teeth were machined in a large gear planer, it being considered preferable to plane the teeth rather than mill them on account of the extraordinary dimensions of the gears. The gears are to be used in connection with the drive of a mining hoist in the Lake Superior copper mines.

New Indicator Reducing Motion.

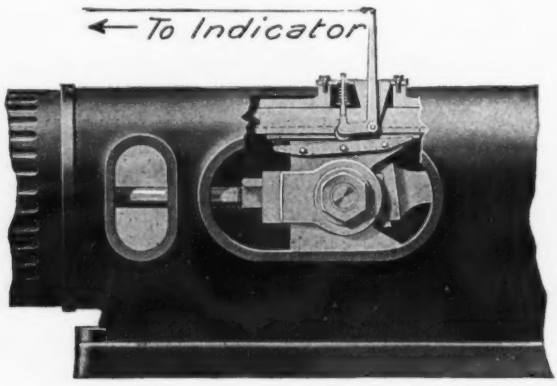
IT is probably well within the bounds of accuracy to state that nine engineers out of every ten would take indicator cards more frequently, and profit by the results of such constant diagnosis of the inside workings of the engine, if it were not for the trouble and delay which is involved in taking indicator cards from the average engine. Methods have been devised by the score for reducing the motion of the cross-head, but many of these are systems of levers, quite unsightly in appearance and more or less cumbersome, which no engineer wants to leave on his engine ready for use at any or all times. The reducing wheel is about as simple and compact as anything could be, but it involves two decided disadvantages. The first is the difficulty of securing a correct transfer of relative motion through the more or less elastic and highly flexible string, and the second involves the by no means simple task of hooking the string on to the moving cross-head when it is desired to take cards. Nearly all systems of levers used as indicator reducing motions have considerable lost motion and irregularity, in

addition to their other faults, and no reducing rig in general use at the present time is capable of being thrown in and out of gear in an instant without trouble or danger, or without stopping the engine.

In view of these facts it is no wonder that the average engineer will not go to the trouble of constantly assembling his indicator rig, hooking it up on the engine and taking cards. It is hardly necessary to point out to any experienced engineer or manager the benefits to be derived from the frequent study of the engine, not only as a means of securing and maintaining the best possible adjustment, but of constantly keeping one's finger upon the pulse of the machine to detect any departure from the normal.

In view of these conditions the reader will be interested in a new indicator reducing motion, on which patent has been lately applied for by F. H. and F. O. Ball of the American Engine Co., Bound Brook, N. J., and which is seen for the first time as one of the details of the new American-Ball "Angle Compound." There exists, however, no reason why this indicator rig should not be applied to other engines, inasmuch as its design and construction involve no features which should forbid its use on Corliss type engines, or any other type of reciprocating engine.

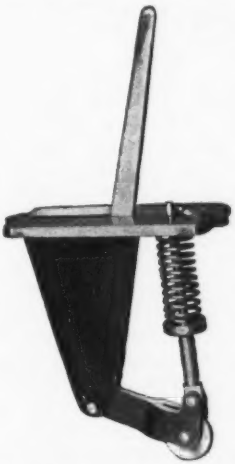
The illustration, Fig. 1, A and B, shows the elevation and end view of the complete rig in connection with the cross-head. It will be seen that the device consists essentially of a slotted plate through which moves an L-shaped lever. At the elbow this lever is pivoted through a bolt, at the apex of a triangular slotted plate cast as one with the outer plate of the device, and at right angles to it. The short arm of the L-shaped lever is forked. A small wheel or roller is set in the fork by means of a pin. Also connected with this arm is a pin which works through and at right angles to the outer plate. A helical spring, pressing against the outer plate and a disk resting on the shoulder of the pin, constantly tends to maintain the L



arm at the extreme end of the slot. The device is fastened to the frame of the engine by bolts.

On the cross-head is secured, by means of bolts, a cast iron cam plate or slide set at an angle in the vertical plane with the lower end directed away from the cylinder and at such an angle that the lower or front end is about two inches below the rear end. The angle of this cam plate is determined by the length of the stroke of the engine, so that the same difference in height between the front and rear ends of the plate will be preserved in all cases. It will be seen that when the cross-head is in position nearest the cylinder the lower end of the cam plate or slide attached to the cross-head is in contact with the wheel or

roller at the lower end of the L arm, and as the cross-head travels forward this wheel or roller, with its arm, is



raised in exact proportion to the piston travel against the pressure of the spring; the reverse taking place as the cross-head returns. The strength of the coiled spring is sufficient to prevent any lost motion with this device, even in a high speed engine. It will furthermore appear that the adjustment of the cam-plate can always be so arranged that the travel of the upper end of the L arm is exactly that desired to turn the indicator cylinder the required distance without further reduction.

Referring to the last half-tone illustrations, it will be seen that on top of the exterior plate is a small flat trigger or lock which engages with a slot milled into the spindle or pin working in and out through the plate. Thus when the pin is pushed to its extreme top position, the trigger can be slipped into the slot and the rig instantly thrown out of engagement. It is but the work of an instant to release the trigger and to throw the indicator rig into service.

As far as the exterior appearance of this rig is concerned, the only visible portion is a highly polished oblong metal plate on the engine frame with a slot through which projects a 6 or 7 inch lever with a hole in the top. The indicator cord may be kept constantly attached to the lever, and cards taken continually, if so desired. The rig is thrown in and out of service as many times as desired by the simple turn of a wrist.

Piling Puller.

THE accompanying cut illustrates a piling puller that is adapted for pulling channels, beams, sheeting, etc., and will reduce labor cost materially. It is made entirely of steel, the jaws being 4 inches wide with case hardened teeth. The machine is simple and requires practically no maintenance. The chain is ¾ inch size and made of BBB refined iron. The little short chain holds the jaws apart so the puller can be let down on the piling. By releasing the short chain, the jaws clutch the piling and the harder the pull on the chain the greater the grip

on the piling. The manufacturers, Curtis & Co. Mfg. Co., St. Louis, Mo., can ship same out of stock.

NEWS SUPPLEMENT

The Engineering Magazine—August, 1908

Personals.

—Henry Lomb, one of the founders of the Bausch & Lomb Optical Co., Rochester, died recently.

—J. A. Werner, for many years locomotive coaling engineer for the Link Belt Co., has recently severed his connection with that company and assumed charge of the coaling station department of the Jeffrey Manufacturing Co. of Columbus.

—Dr. Heraeus has been awarded the John Scott Legacy Premium and Medal of the Franklin Institute, Philadelphia, for his improvements on the Heraeus Le Chatelier pyrometer, and the accuracy and interchangeability of the thermocouple, which he has produced, known as the Heraeus Element, and represented by Charles Engelhard, Hudson Terminal Buildings, 30 Church St., New York.

—Theodore T. Mersereau, formerly United States Local Inspector of Boilers of Steam Vessels, Port of New York, has been appointed sales agent for the marine department of the Casey-Hodges Co., Chattanooga, Tenn., who have decided to extend their business and compete for the marine work on the North Atlantic Coast. Their branch office is at 100 William Street, New York.

Industrial Notes.

—Scully Iron and Steel Co., Chicago, has absorbed the plants and the business of Kelley, Maus & Co., Chicago.

—Aberthaw Construction Co., 8 Beacon St., Boston, have issued a small booklet showing views of structures erected by them.

—The Pittsburg Steel Supply Co. have recently been appointed agents for the Pittsburg district representing The American Steam Gauge & Valve Mfg. Co.

—The Electric Controller & Supply Co., Cleveland, Ohio, has changed its name to The Electrical Controller & Mfg. Co. The latter name more truly indicates the nature and scope of its business.

—Carbolineum Wood Preserving Co., 349 West Broadway, New York, have issued a pamphlet containing a reprint of an article that appeared in the *Street Railway Journal* on the open tank treatment for preserving ties and cross-arms.

—Consolidated Engineering & Construction Co., 1 Madison Ave., New York, are distributing a pamphlet containing pictures showing method of construction accompanied by historical and technical sketch of the Syracuse University Stadium.

—Norton Company, Worcester, are circulating a booklet entitled "Helps—Dont's." It treats of the selection and use of grinding wheels and grinding in general. The booklet will be found to contain much valuable information.

—J. A. & W. Bird Co., Boston, have issued four of a series of six semi-technical talks on belting. The subjects treated are Belt Drive Design; Power of Belting; Miscellaneous Notes on Belting; and Quarter-Turn Drives.

—DuBois Iron Works, DuBois, Pa., have issued the first of a series of twelve monthly calendars which they will send to the machinery trade throughout the country. The series will depict "Child Life" in Holland as seen by the artist, Miss May Audubon Post.

—Ridgway Dynamo & Engine Co., Ridgway, Pa., have concluded negotiations with the Machinery Sales Agency, 1021 Prudential Bldg., Atlanta, whereby they will handle their complete line of side and center crank engines, as well as direct current electrical machinery.

—Among recent improvements made in connection with the plant of the Massachusetts Fan Co., Watertown, Mass., has been the introduction of a spur track, the erection of a crane for loading and unloading, and the general grading and beautifying of the grounds.

—DuBois Iron Works, DuBois, Pa., advises that Robert R. Harkins, their representative at Cleveland, has associated him-

self with his father, Cass Harkins, formerly manager of the Atlas Engine Company, Columbus, O. The firm name will be Cass Harkins & Son, with offices at 1419 Schofield Building, Cleveland, O.

—Another order for "Swartwout" gravity closing ventilators, the fourth in the series, has recently been received by The Ohio Blower Co., Cleveland, from the Richardson Paper Co., Lockwood, Ohio. This order adds twelve more 24 and 36 inch ventilators to the 54 already furnished this company—a total of 66 in four months.

—The Massachusetts Fan Co., Watertown, Mass., were the successful bidders for the elaborate heating and ventilating equipment to be installed at the new Great Lakes Naval Training Station, Lake Bluff, Ill. This includes 12 complete heating apparatus (each consisting of fan, belted motor and heater) and 11 independent ventilating fans.

—The Electric Welding Products Co., Cleveland, has recently installed a grinding and finishing department, consisting of several Brown & Sharpe plain and universal grinders, special imported machines for spline milling or slot cutting, as well as centering machines. With the aid of this department the company is able to turn out a product completely finished in every detail.

—The following officers of the Crocker-Wheeler Co., manufacturers and electrical engineers, of Ampere, N. J., were elected July 10: President, S. S. Wheeler; vice-president, Gano Dunn; second vice-president, A. L. Doremus; chief engineer, Gano Dunn; secretary, Rodman Gilder; treasurer, W. L. Brownell; assistant secretary, J. B. Milliken; assistant treasurer, G. W. Bower.

—Among the many improvements that are being made by the Tennessee Coal, Iron & Railroad Co., at the Ensley, Ala., plant is the providing for a supply of soft, clear water for boiler feed. A contract has just been entered into with Wm. B. Scaife & Sons Co., Pittsburg, to remodel their present water softening and purifying system and convert it into a We-Fu-Go system with a capacity for 35,000 H.P. of boilers.

—The General Electric Co., Schenectady, N. Y., has just issued a very comprehensive bulletin devoted to the subject of "Railway Converter Sub-Stations." The publication gives a general description of the various pieces of sub-station apparatus, including rotary converter transformers, reactances, blowers, cables, switchboards, etc., and includes illustrations of converter stations operated by various well-known railway companies. It contains also plans and elevations showing different arrangements of sub-station apparatus.

—*The General Electric Review*, Schenectady, N. Y., for July contains the following articles: Automatic Feeder Regulators; Continuity of Education, by Frederick P. Fish; Forestry and Hydro Electric Development, by H. L. Smith; Electric Automobiles, by Alex. Churchward; Patents, Part II, by Albert G. Davis; Electrification of the Harlan and Hollingsworth Plant, by H. B. Emerson; The Flame Carbon Arc Lamp, by S. H. Blake; Presentation of the Perkin Medal, by Dr. C. F. Chandler; Rotary Converters, Part VI, by Ernst J. Berg; The Schenectady Section, A. I. E. E., and Note on Gyroscopic Forces.

—The DuBois Iron Works, DuBois, Pa., have established agencies at the following points for the sale of their gas and gasoline engines and producer gas plants, also steam and power pumps: Anderson & Gaylord, 1107 Real Estate Trust Bldg., Philadelphia; General Supply Co., Independencia, No. 28, Mexico, D. F.; Barden Electric Co., 109 Main St., Houston, Tex.; Hampson & Fielding, 1711 Tremont St., Denver; A. C. Stansill, 5 Church Ave., Roanoke, Va.; B. S. Middleton, Goldsboro, N. C.; Cass Harkins & Son, 1419 Schofield Bldg., Cleveland; Geissendorff & Schlotzhauer, Indianapolis.

—Announcement is made that The Cutler-Hammer Mfg. Co., Milwaukee, makers of electric controlling devices, has just completed arrangements whereby this firm will be represented on the Pacific Coast by Otis & Squires, 111 New Montgomery St., San Francisco. A large stock of standard Cutler-Hammer controllers will be carried by Otis & Squires, enabling them to make prompt delivery of apparatus. A. W. Vinson, who has for several years been con-

nected with the engineering department of The Cutler-Hammer Mfg. Co., has been transferred to the office of Otis & Squires.

—The C. S. McKinney Co., 60 Wall Street, New York City, have reprinted in pamphlet form an article on the subject of wood preservation entitled "Carbolineum Combination Process," which appeared in the October, 1907, issue of this Magazine. Copies of this pamphlet may be had free of cost on application to that company. Dr. McKinney, senior member of the firm, is one of the pioneers in the art of wood preservation, having given the subject his undivided attention for some twenty years past. Many valuable articles from his pen have appeared in the publications of the Engineering Association of the South, of which he is a member, as well as in the various engineering journals. Dr. McKinney has given special attention to Carbolineum of different grades and brands with a view to adapting the preservative to the peculiar character of the different woods to be treated, and the exposure to which they will subsequently be subjected.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

Bolt Cutters.

LANDIS TOOL CO., Waynesboro, Pa.—Illustrated catalogue describing bolt threading, pipe and nipple threading and nut tapping machinery, and special threading machines. 6 by 9 in.; pp. 40.

Cableways.

LIDGERWOOD MFG. CO., 96 Liberty St., New York—Illustrated catalogue describing cableways for hoisting and conveying. Also contains numerous views of recent installations. The catalogue is well printed. 9 by 12 in.; pp. 168.

Cold Saws.

BURKE MACHINERY CO., Cleveland—Circular giving a brief illustrated description of cold saws, together with specifications and prices. 5 by 7 in.; pp. 4. Also a leaflet giving specifications of their No. 4 milling machine.

Drill Chucks.

T. R. ALMOND MFG. CO., Ashburnham, Mass.—Folder containing an illustrated description, with prices and sizes, of drill chucks. 3½ by 6 in.; pp. 6.

Electric Heating.

SIMPLEX ELECTRIC HEATING CO., Cambridge, Mass.—Catalogue No. 15 illustrates and describes electric chafing dishes; coffee urns; dining room sets; plate and food warmers; household appliances, etc.; together with prices. 5½ by 8¼ in.; pp. 120.

Foundry Equipment.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—Illustrated catalogue describing everything needed in a modern foundry, from a 30 lb. ladle to a 200 ton electric crane. 6 by 9 in.; pp. 32.

Hoisting Machinery.

BROWN HOISTING MACHINERY CO., Cleveland—Catalogue O illustrates and describes machinery for the handling of coal, coke and other materials as used about gas, coke and electric light plants. Also contains a number of views showing actual installations. 6 by 9 in.; pp. 24.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia—Catalogue containing a reprint of a paper read by Grafton Greenough before the Engineers' Club of Philadelphia, March 21, 1908, presenting some facts concerning articulated compound locomotives of the Mallet type. 9 by 6 in.; pp. 46.

Lubricant.

ACHESON OILDAG CO., Niagara Falls, N. Y.—Booklet describing a lubricant known as "Oildag." Also contains numerous testimonial letters from recent users. 3½ by 6 in.; pp. 12.

Machine Tools.

GISHOLT MACHINE CO., Madison, Wis.—Booklet showing in compact and convenient form turret lathes, boring mills, grinders, drilling machines, gear testing machines, chucks, etc. 3½ by 6 in.; pp. 72.

Milling Machines.

PRATT & WHITNEY CO., Hartford—Well-printed catalogue illustrating and describing the Spline milling machine. Also contains tables giving dimensions. 9 by 12 in.; pp. 12.

Mine Fans.

JEFFREY MFG. CO., Columbus, O.—Catalogue No. 26 illustrates and fully describes the construction and operation of centrifugal fans for mine ventilation. 6 by 9 in.; pp. 24. Also cata-

logue No. 31 A treating of crushing and pulverizing machinery. Illustrated. 6 by 9 in.; pp. 80. Bulletin No. 14 is devoted to an illustrated description of coal cutters for room and pillar mining. 8 by 10 in.; pp. 12.

Motors.

CROCKER-WHEELER CO., Ampere, N. J.—Bulletin No. 105 illustrates and describes polyphase induction motors. 7¼ by 9¾ in.; pp. 12.

Oil Filters.

SYRACUSE GAUGE MFG. CO., Syracuse—Bulletin No. 1 illustrates and describes oil filters and continuous oiling systems, together with tables giving dimensions, capacities and prices. 8 by 11 in.; pp. 28.

Pumps.

GOULDS MFG. CO., Seneca Falls, N. Y.—Folder containing an illustrated description of lift and force pumps for hand and windwill power. Also contains tables giving sizes, capacities and prices. 4½ by 7¼ in.; pp. 6.

Punches and Shears.

CLEVELAND PUNCH & SHEAR WORKS, Cleveland—Catalogue A illustrates and describes punching and shearing machinery, together with tables giving capacities. 12 by 9 in.; pp. 66.

Reinforced Concrete Construction.

EXPANDED METAL AND CORRUGATED BAR CO., Frisco Bldg., St. Louis—The June issue of "Designing Methods" gives a detailed design of a typical building and also a complete analysis of the strength of rectangular and "T" shaped beams. 5¾ by 8½ in.; pp. 36.

Scales.

BUFFALO SCALE CO., Buffalo, N. Y.—Folder illustrating and describing suspension crane, platform, wheelbarrow, dormant, miners' and transportation, and track scales, together with prices. 3½ by 6¼ in.; pp. 12.

Skylights.

CANTON ART METAL CO., Canton, O.—Catalogue illustrating and describing skylights and ventilators for all purposes. Also contains views of buildings equipped with their skylights and ventilators. 9 by 6 in.; pp. 24.

Steam Traps.

RICHARD J. FLINN, West Roxbury, Mass.—Bulletin illustrating and describing the operation of the Flinn steam trap. Also gives a table showing the capacity in pounds per hour. 6½ by 9 in.; pp. 4.

Superheaters.

HEINE SAFETY BOILER CO., 421 Olive St., St. Louis—"Superheater Logic" is the title of a pamphlet giving very briefly some of the considerations covering superheater design and also a description of the Heine superheater, which supplemented by the illustrations gives a clear understanding of the apparatus. 6 by 9 in.; pp. 12. "Boiler Logic" is intended to indicate to boiler users, engineers, and others, their position in the boiler field. Also contains as complete a description as can be briefly done. 6 by 9 in.; pp. 24.

Thermometers.

BRISTOL CO., Waterbury, Conn.—Bulletin No. 92 ilustrates and describes recording thermometers for temperatures between 40 and 500 deg. Fahrenheit. 8 by 10 in.; pp. 16.

Vacuum Valves.

SIMONDS HEATING & SPECIALTY CO., Detroit—Booklet containing a brief illustrated description of automatic vacuum valves as employed in steam heating systems. 3¼ by 5½ in.

Water Wheels.

PELTON WATER WHEEL CO., 2225 Harrison St., San Francisco—Bulletin No. 4 contains tables of the power of water under pressure, impulse wheel tables and water consumption in both miners inches and cubic feet per minute; a table of riveted hydraulic pipe showing safe heads for various sizes of double riveted sheet steel water pipe; table of approximate friction losses in water pipes discharging various quantities of water. The bulletin contains much interesting hydraulic information pertaining to impulse water wheels and will be found a ready reference to parties interested in this subject. Illustrated. 6 by 9 in.; pp. 20.

Wind Mills.

FLINT & WALLING MFG. CO., Kendalville, Ind.—Catalogue No. 57 illustrates and describes Star Windmills. Tanks and hand pumps are also treated. 6 by 8 in.; pp. 46.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

SITUATIONS WANTED

INDUSTRIAL ENGINEER (44) with new and very advanced ideas as to the management of industrial operations, acquired during a long and varied experience in the design of manufacturing plants, desires connection with progressive manufacturer who is open to the suggestions which are to be derived from the application of the analytical, logical, graphical and constructive methods of the engineer to the solution of problems in the improvement of methods, records and management. Correspondence is especially invited from those who have suffered from the limitations of "public accountants." Address Box 123, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York, N. Y. 1-8

CORNELL GRADUATE Mechanical Engineering course; has strong endorsements, including Faculty of Adelphi Academy, Brooklyn, where he attended for twelve years. Young man of powerful constitution—seeks suitable employment. Address Box 124, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-8

PHILADELPHIA TERRITORY. Would take sales agency or sell on commission anything requiring mechanical knowledge and experience. Am a successful salesman, 30 years old, several years with present concern and leave them voluntarily. Prefer a proposition that will develop a permanent business. This is a good opportunity for a new line or new territory or to raise the reputation of a standard line. Address Box 125, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-8

MECHANICAL ENGINEER, well acquainted in New England, is opening a sales office in Boston for power plant apparatus, and can take on additional lines. Correspondence invited. Address Box 126, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-8

MECHANICAL-INDUSTRIAL Engineer. Stevens Institute. Experience in construction work and in the mechanical features of large factory operation, cost reduction and the work of by-product utilization. References of highest class. Box 127, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-8

BOOKS

THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guess-work; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

EVERY PRACTICAL ENGINEER should compile his own note book. Subscribe for Webber's tables, printed on 4x7" sheets, for insert binders. Every engineering subject, 25 cts. per sheet, printed on both sides. Write for information to WILLIAM O. WEBBER, Consulting Engineer, 432 Exchange Building, Boston, Mass. 12-8

THE ENGINEERING INDEX ANNUAL for 1907 embraces all branches of engineering, and clearly indexes alphabetically by subject about 9,000 important articles of permanent value which appeared during 1907 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 450 pages, 9½ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Glue Cookers.

THE accompanying cut shows a 10-gallon glue cooker shipped to the J. B. Lyon Company, Albany, N. Y., by the Westinghouse Electric & Mfg. Company. The Westinghouse Company builds a line of these cookers ranging from 5 to 25 gallons in capacity, and they are used by the manufacturers of printing press rollers, by bookbinders

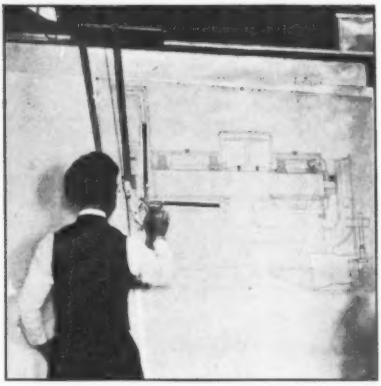
and large cabinet wood shops where it is necessary to melt and keep in working condition large quantities of glue or other compositions for replenishing the smaller glue pots used on the bench. These glue cookers are arranged with two heats, a high heat for melting down raw stock, and a low heat for holding the stock at a working consistency.

A New Drafting Instrument.

THE Emmert Mfg. Co., of Waynesboro, Pa., have undertaken the manufacture and sale of the Noyes vertical T-square, a drafting instrument of considerable novelty. This instrument comprises a vertically arranged T-square, guided at the top of the drawing board and having a protractor with scales sliding vertically thereon. The head of the T-square is provided with a set of four rollers guided upon a straight steel track which is fastened to the top of the drawing board. One pair of these rollers is bevelled, and runs on ball bearings so arranged that the weight of the head holds it upon the track with absolutely no lost motion, making possible a very free and sensitive movement. The head also carries a spring balanced drum to which is attached a cord which connects with the vertically sliding protractor and acts to hold the latter to the blade. The protractor is also guided upon the blade by rollers, giving it a very sensitive vertical movement. It is thus evident that the instrument always moves in horizontal and vertical parallel lines.

Pivoted to the sliding protractor is a forked arm to which interchangeable scales are attached. This arm is provided with a worm which engages notches cut in the rim of the protractor and which can be quickly pressed out of engagement therewith. These notches are spaced three degrees apart, thereby making possible an instantaneous setting of the instrument to any multiple of three degrees, which includes all the most commonly used angles: 0, 15, 30, 45, 60, 75 and 90. The 3-degree angle is exceedingly handy as it is the usual

draft given to patterns, is suitable for the conventional angle used for showing screw threads and various other cases. To obtain fine adjustment, the neck of the worm is graduated with 12 divisions so that one division represents ¼ of a degree. One half of this, or ⅛ degree, can be easily read, which is as fine as is ever necessary for drawing. Interchangeable scales are provided, furnished with any desired graduations.



In addition to the obvious advantages of the instrument for the horizontal board, it is practically indispensable for the vertical. It combines T-square, protractor, scales and triangle into one self-contained whole, depending from the top of the board. It eliminates the use of the parallel rule, with its inaccuracies and troubles, and its speed and accuracy in making projections alone will pay for its installation. A further extension of its use is in the making of large drawings. With this outfit it is possible to make full size drawings of quite a large machine with the same ease, accuracy and speed as on a 24 x 36 board.

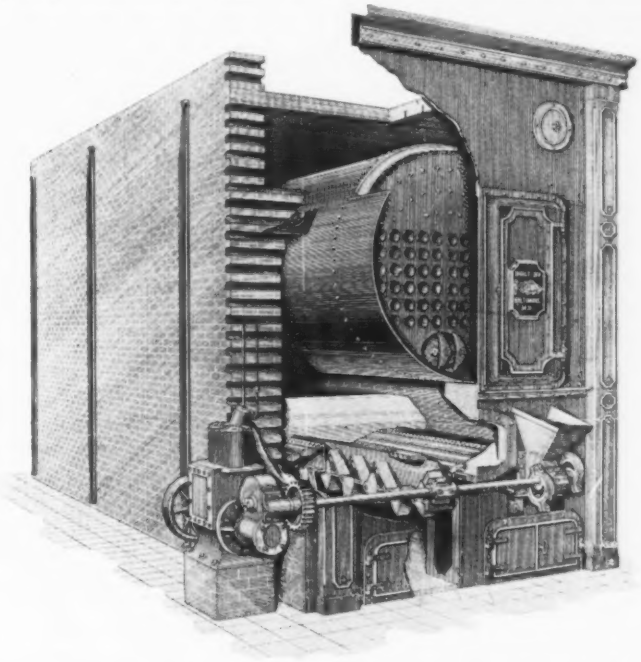
The advantages of this outfit will be readily apparent to every designer. Full size assembled drawings, with every part standing up in its natural and normal life size position, furnish almost the same advantage as a model. With such a layout the location of operating mechanism and handles can be tried, and their convenience and accessibility can be determined and a more accurate scale layout is always possible when full sized scale is used.

The Luckett Stoker

ENGINEERS and steam consumers should be interested in the demonstration of the capabilities of the Luckett Stoker, in operation in its daily routine at the boiler and machine works of E. J. Codd Company, Baltimore, Md. Since its operation one would judge by the appearance of its smokeless stack that the works were shut down. The plant is running and besides having a smokeless stack there is a saving in the consumption of coal.

This stoker as shown in the cut is very simple in construction and its operation can be readily understood by anyone. In the furnace there are two magazines so placed that each one will take care of half the width of the furnace. On the sides of these magazines are the grates which incline down toward the center and sides of the furnace. At the front end of each magazine is a hopper to which the coal is fed, either by the fireman or by chutes leading from the bottom of coal-bins overhead. After the coal is conveyed to the hoppers it is conveyed into the furnace by what are termed conveyors, the number depending on the depth of furnace. These conveyors oscillate about a shaft and work alternately, that is, while one is moving up the other is moving down. By this action the coal drops or fills in front of the conveyors, the first one pushes it back under the dead plates, and as it reaches its extreme forward position, the second conveyor has reached its extreme lower position and takes the coal that has been conveyed forward by the first conveyor and pushes it up the inclining bottom, known as uptakes, which is then partly thrown over the top of same to be conveyed by the third conveyor and partly pushed to the fire surface. This process is repeated by the succeeding conveyors. The conveyors are set so that each succeeding one will take a certain proportion of the coal conveyed to it, leaving the remainder to be pushed to the fire surface. This proportion is constant, no matter how fast or how slow the coal is fed. The portion of the coal in the course of being pushed to the fire surface is

gradually heated and ignited and thereby formed into coke. The process being continuous, heaps up the formed coke above the magazine which, partly through gravity and partly through the action of the conveyors, falls to the inclining grates on the sides and is gradually worked to the center and sides of the furnace. The continuous oscillating motion of the conveyors, gives a breathing motion to the fire bed, keeping it open and free for the circulation of air and doing away with the slice bar. In the conveyors, does away with the opening of the furnace doors for firing and slicing of fires. This saves the boiler and furnace from the objectionable inrush of cold air, and therefore eliminates smoke and destructive gases and maintains a uniform condition in the furnace and boiler. It is simple in construction; works automatically; saves fuel; is smokeless; no forced draught necessary; and there is no opening of furnace doors, which saves the boiler from sudden shocks of inrushing cold



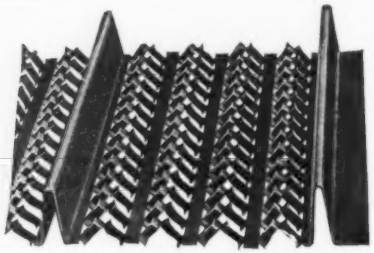
the center and sides of the furnace, the grates are made to shake at will of fireman. The conveyors of each magazine are operated by arms and rods connected to two eccentrics attached to shaft in front of boiler, known as stoker shaft. This shaft is driven by an engine placed at right angles to it, at the side of the boiler, connected through a reducing worm and spur gears.

It will be seen that the principle of feeding the coal continuously into the furnace below and the lifting effect of air, causing contraction and expansion, resulting in ruptures, etc. Should anything happen to the stoker, which is not very likely, the boiler can be fired by hand.

Hy-Rib Sheathing.

THIS is one of the "Kahn System" products placed on the market by the Trussed Concrete Steel Co. of Detroit. It consists of a series of high ribs 13/16 inch high 3½ inches apart rigidly

connected by rib lath. The ribs and the lath are manufactured complete from a single sheet of open hearth steel. The ribs give great strength and rigidity to the sheathing, make it self-centering for floors and roof, and entirely do away with studs in wall and partition construction. The Rib-Lath furnish a perfect surface for plastering; at the same time, it accurately locates the ribs and holds them rigidly in place. One of the uses of Hy-Rib sheathing is in connection with roof and light floor construction. When so used, the sheathing supplies, itself, the centering for the slab, reinforcement for the concrete, and a perfect surface for plastering underneath.



The construction is very simple. Lay Hy-Rib sheathing over the supports and pour in the concrete above. The concrete flows through the sheet only enough to supply a perfect key and there is no leakage. The plastering is applied directly to the under surface. For long span and heavy warehouse floors, Hy-Rib is also used without centering and is then curved into the form of an arch. For wall and partition work, Hy-Rib sheathing combines in a single sheet the ordinary lath and separate stud construction. It entirely does away with the use of studs. Simply set up the sheets, plaster both sides, and the wall is complete. It saves in the labor of wiring many sheets of lath to separate studs, besides being cheaper in first cost.

Hy-Rib sheathing is especially suitable for walls of foundries, car barns and industrial plants. It furnishes an indestructible fireproof construction in place of the short-lived corrugated sheathing and inflammable wooden construction. It is ideal for sidings of stucco houses and for constructing farm buildings, for partitions in office buildings, public buildings and hotels. For furring either the outside or inside of walls, the Hy-Rib is fastened against the wall with the lath side outward, thus furnishing a ¾ inch air space back of the lath, and no studs whatever are necessary. Similarly in suspended ceilings, Hy-Rib sheathing does away with the use of numbers of small channels and T's, commonly used as ribs, give the requisite stiffness.

Hy-Rib sheathing is manufactured in four thicknesses of metal represented by U. S. standard gauges Nos. 30, 28, 26 and 24. It is furnished in sheets 10½ inches wide measured from center to center of outside ribs and is 6, 8 and 10 feet long. The sheathing is manufactured with a full size rib on either side, thus providing a perfect interlocking point when two sheets are spliced together.

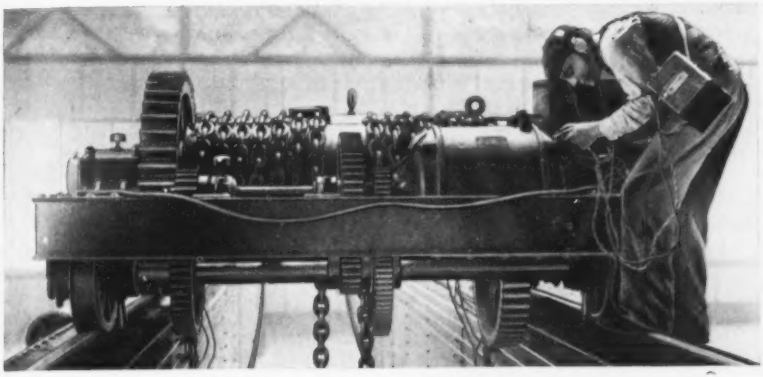
The Electric Fault Finder.

A NEW and useful instrument has just been brought out by The Electric Controller & Mfg. Co. of Cleveland, Ohio, for detecting and locating grounds, short circuits, open circuits, leaks and other faults in armature coils, field coils, control circuits, switchboard wiring or any other electrical circuit. Its name, the Electric Fault Finder, truly describes its use, since it not only indicates trouble, which is all that a magneto will do, but finds or locates the trouble. With the Electric Fault Finder, for instance, in a motor armature, a faulty coil can be absolutely located and the nature of the trouble definitely told. If a field coil is damaged, the layer in which the fault lies can be absolutely determined. If there is trouble in a bunch of control wires, in a multiple unit, train control, or other magnetic switch control, the faulty wire or pair of wires can be promptly located and the nature of the fault quickly found.

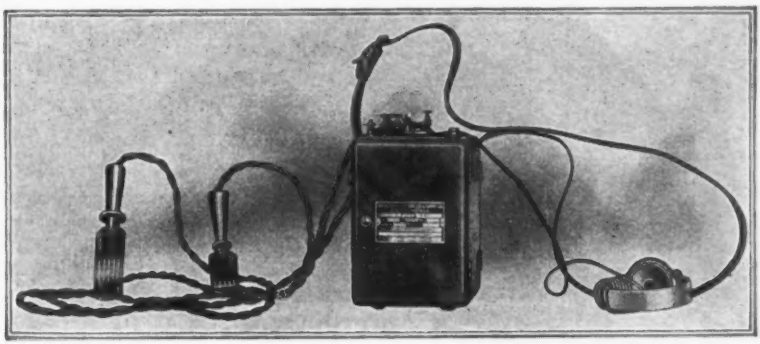
As will be seen from the accompanying views, the instrument consists of a small box provided with a strap so that it can be slung over the shoulder when

testing motors in place, such as under a car or on an electric overhead traveling crane. From this small box leads go to a telephone receiver fitted with a head piece so as to leave both hands free for testing. For working in very noisy places, such as bridge and boiler shops, or some parts of steel mills, the head piece may be fitted with two receivers, one for each ear, which will shut out all sound save that received from the instrument. This arrangement not only allows perfect testing to be done in noisy places, but enables partially deaf persons to use the instrument. In one case, by adjusting the rheostat to give a very loud sound (more than the normal ear could stand) and using two receivers, a very deaf man did very accurate work with this instrument. From the box, leads of convenient length go also to two test terminals.

The Electric Fault Finder is small, portable and requires no outside current to operate. It requires only one man to operate under any conditions, so there is no excuse for the tester desiring a helper.



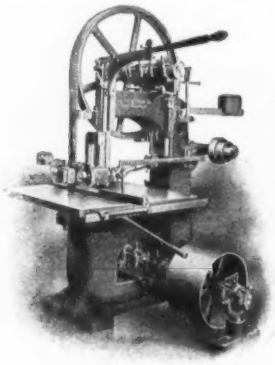
The Electric Controller & Mfg. Co. have prepared a neat little booklet describing the Electric Fault Finder and giving instructions in its use, which will be sent to interested persons upon request.



New Band Rip Saw.

THE machine illustrated herewith is claimed to embody every modern improvement in band saw construction and to stand the wear and tear of continuous service. It is especially built for car shop work and is used in the leading car shops of America. It rips 24 inches wide and takes 12 inches under the guide.

The feed rolls are powerfully driven and placed close together, enabling short stock to be fed successfully. The saw guides have sectional hardwood blocks arranged to permit of taking up the slightest wear. The machine is built along the same lines as the Fay & Egan No. 1 machine, but in addition to the features of the older tool it has other



improvements designed to give it a maximum of efficiency.

The straining of the blade is accomplished by a knife-edge balance and the claim is made that the lightest blades may be run at the highest speed without danger to saw or operator. The saving in time and kerf is said to be very large. The machine is known as No. 180. The maker is the J. A. Fay & Egan Co., 212-232 W. Front St., Cincinnati, Ohio.

Personal.

—John Wilkes, manager of the Mecklenburg Iron Works, Charlotte, N. C., died recently.

—Charles W. Barnaby, a mechanical engineer of wide practical experience in the East, middle West and abroad, has opened a consulting engineer's office at 309 Broadway, New York.

—J. B. Kane, who has had several years' experience in the factory of The American Steam Gauge & Valve Mfg. Co., Boston, has been promoted to the position of salesman and will make his headquarters at their New York branch.

Industrial Notes.

—Merritt & Co. announce the removal of their general offices from Philadelphia to Front and Arch streets, Camden, N. J.

—Hanna Engineering Works, 820 Elston avenue, Chicago, announce that they have recently added the entire riveting business of Quincy, Manchester, Sargent Co., Plainfield, N. J., to their line.

—The National Metal Moulding Co. has decided to enlarge its factory at Economy, Pa. Contract for the structural steel work has been awarded to Wm. B. Scaife & Sons Co., Pittsburg.

—William B. Scaife & Sons, Pittsburgh, have received contract for the new steel frame buildings required for the extension to the plant of the Driggs-Seabury Ordnance Corporation at Sharon, Pa.

—Gas Machinery Co., Citizens' Building Cleveland, announce that Wile producers formerly furnished by the Wile Power Co., will hereafter be exclusively manufactured and sold by them. J. I. Wile will be sales manager of the Wile Producer Department.

—Barrett Manufacturing Co., New York, have issued a well-printed pamphlet telling what their dust layer, known as "Tarvia," will and will not do. It also contains illustrations of quite a number of macadamized roads which have been made dustless by the application of Tarvia.

—The Cement Securities Co., Denver, have appointed F. L. Smidth & Co., 41 Cortlandt St., New York, their consulting engineers. The Securities Co. controls Portland cement plants operating at Portland, Colorado, and Devils Slide, Utah, and under construction at Three Forks, Montana, and El Paso, Texas.

—Another indication of the increasing business revival is to be found in the contract that has just been awarded by Harry E. Danner to Frank B. Gilbreth, general contractor, New York, for a cotton mill which is to be erected at Paterson, N. J., at a cost of $100,000. Construction is to begin immediately.

—H. W. Caldwell & Son Co., Chicago, have issued a booklet entitled "Something Better" in which they illustrate and describe machinery furnished Hecker-Jones-Jewell Mill, New York City. The pamphlet

is a little out of the ordinary in respect to reading matter and method of presenting the subject.

—The Mesta Machine Co., Pittsburg, has opened an office in Chicago at No. 844 Commercial National Bank Building, from which point the company's business in rolling mill machinery, gas and steam engines, condensers and machine molded gears, steel castings, etc., will be taken care of by Lane Johnson.

—The Pittsburgh Emery Wheel Co., Park Building, Pittsburgh, advise that they have been successful in bringing some vitrified emery wheels through on an order in perfect condition with 26-inch width of face. This is the second order of this kind that they have brought through successfully.

—In printing last month the very excellent paper on "The Correct Way to Apply Detachable Chain" due credit to the author of it was unfortunately omitted. This most excellent exposition of the reasons for running detachable chain in specified ways was prepared by Mr. S. B. Peck, vice-president of the Link-Belt Company, Chicago, Ill., who also furnished the lucid drawings which accompanied the explanations.

—The *Progress Reporter* for July, published by Niles-Bement-Pond Co., 111 Broadway, New York, contains numerous articles illustrating and describing a number of different machines manufactured by them; such as their combined slotting, boring, drilling and milling machine, 16-25-foot heavy pattern extension boring mill, 48-inch Niles steel-tired car-wheel lathe, 90-inch tire mill, 60-inch forge lathe, etc.

—Northwestern Expanded Metal Co., Old Colony Building, Chicago, have issued a booklet entitled "Expanded Metal Information," containing many valuable hints on specifications for reinforced concrete structures. They also have in course of preparation a series of pocket size booklets on kindred subjects and they will be glad to send them on application to all interested parties.

—The Trustees of the University of Illinois have recently let the contract for a new building for its College of Engineering, to be occupied wholly by the Department of Physics. The structure is to be built by B. Jobst & Sons, of Peoria, Ill., and is to cost, with its equipment, $250,000. It is to be erected just east of the present Engineering Building, and is to be known as the Physics Building.

—Turner Construction Co., 11 Broadway, New York, have been awarded the contracts for constructing the reinforced concrete floor in the car barn of the Third Avenue R. R. Co., at Sixty-fifth street and Third avenue, New York, and for the erection of approximately 1,000 feet of reinforced concrete fence on Sixth avenue, between Atlantic avenue and Pacific street, Brooklyn, for the Long Island R. R.

—The increasing trade of The S. Obermayer Co., in and around Erie, Pa., has made it necessary for them to open a branch warehouse in that city. W. L. Scott is in charge, and a full line of foundry facings, core compounds, plumbago and blackings will be carried for the present; and just as soon as conditions warrant their doing so a complete line of other foundry facings and foundry supplies manufactured by them will be carried in stock.

—A new seamless trolley pole is being put on the market by the R. D. Nuttall Co., Pittsburg. It is made of cold drawn seamless tubing of the highest grade to be obtained. Great strength is insured by a reinforcement at the bottom and a gradual taper at the top. The reinforcement is 16½ inches long and made of the same material as the pole proper. It is inserted cold and with such care as to fit that it practically becomes a part of the pole. The taper begins three feet from the top and reduces the diameter from 1½ inches at this point to one inch at the end. This gives to the pole greater strength and rigidity than is possible with any other design. The pole is made in all lengths up to 18 feet and combines rigidity with light weight. The average weight of the 12-foot poles is 22 pounds.

—The Youngstown Sheet & Tube Co., Youngstown, O., have contracted with Wm. B. Scaife & Sons Co., Pittsburgh, for an addition to their present 15,000-H.P. water softening and purifying system to provide for the 8,000-H.P. boilers which are being added for the operation of their new blast furnaces. The present water softening and purifying system is of the We-Fu-Go intermittent type, and consists of four

large treating and settling tanks and four mechanical gravity filters. When the additional apparatus is installed the system will consist of six large treating and settling tanks and seven mechanical gravity filters, and the total capacity will provide for 23,000-H.P. boilers, or 92,000 gallons of water per hour. Some recent contracts taken by this company are the following: Tennessee Coal, Iron & R. R. Co., 35,000 H.P.; Shenango Furnace Co., 8,000 H.P.; American Steel & Wire Co., 25,000 H.P.; Woodward Iron Co., 10,800 H.P.

—The August number of the *General Electric Review*, published by the General Electric Co., Schenectady, N. Y., contains the following articles: Alternating Current Underground Distribution, Part I, S. D. Sprong; Split Pole Converters, J. E. Woodbridge; Notes on the Desirability of Standard Specifications for Hard Drawn Copper Wire, W. H. Bassett and J. A. Capp; A Modern System of Street Lighting, C. A. B. Halvorson; The Relations Between Commercial and Electrical Engineers, Charles B. Burleigh; Motor Drive in a Soap Factory, C. W. Larson; Mine Haulage, C. W. Larson; Gem High Candle Power Units in the New White Factory, F. W. Willcox; Some Fuel Problems, H. M. Wilson; Heavy Traction Gearing, John Liston; Our Competitors in the Foreign Field, M. A. Oudin; New Alternating and Direct Current Ceiling Fan Motors, H. S. Baldwin; Color and Light, Louis Friedmann, and Notes.

—The DuBois Iron Works, DuBois, Pa., have been awarded the street lighting contract for the town of DuBois. The system will require 125 arc lights with provision for 25 additional arcs as required. The system will be operated entirely by gas engines of the twin tandem cylinder type, belted to General Electric Company's generators of the AC type. Other sales reported by them consist of two 80-H.P. tandem engines with direct connected generators to the Allegheny Trust Co., Allegheny; one 50-H.P. complete producer gas plant to the Philadelphia Gear Works, Inc., Philadelphia, for general service; one 175-H.P. tandem cylinder engine operating on natural gas to the Van Tassel Tannery, DuBois, Pa.; one 60-H.P. tandem cylinder engine direct connected to generator to the Hibner-Hoover Hardware Co., DuBois, Pa.; one 50-H.P. general service engine to the South Cleveland Lumber Co., Cleveland; one 50-H.P. engine to the Tarentum Glass Co., Tarentum, Pa.; one 50-H.P. engine to the Taylor Crush Stone Co., Falls Creek, Pa.; one 32-H.P. plant to the DuBois Laundry Co., DuBois, Pa.

—The Compania de Transvias Luz y Fuerza de Guadalajara, S. A., which company is the result of the combination of the two former electrical companies of that city, and operates not only the entire lighting system, but also the railway system of Guadalajara, have en route to Mexico a large order for additional electrical machinery which was bought from G. & O. Braniff & Company, of Mexico City. In order to meet the increasing demand for electrical power in Guadalajara, this company finding that their power generating stations at La Junta and Juanacatlan were insufficient, found it necessary to purchase a 750 K. V. A., modern, Westinghouse, three-phase, belted type generator, which will be installed at Juanacatlan. This new generator is but one of the four which will be installed as needed. The latter station was one of the first electric power plants in the country; the original installation consisting of single-phase machines, which were added to from time to time by other machines of the same type, as growth necessitated. A more modern method of transmitting electrical energy is by means of three-phase current, on account of the saving of amount of copper required in the transmission line and is now almost universally in use. By this change a greater amount of electrical energy is obtained from the same amount of water power by the adoption of this more modern type of machine, even by the use of the present water wheels, which will be retained in service. The Westinghouse Electric & Mfg. Co., Pittsburg, are supplying the new electrical machinery. This extension was necessitated not only by the operating of electrical railways in Guadalajara, which now have been in service for the last several months, but also by the additional power required from their present and new subscribers.

NEW CATALOGUES AND TRADE PUBLICATIONS

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

Ball Bearings.

HESS-BRIGHT MFG. CO., 21st St. and Fairmount Ave., Philadelphia—Catalogue devoted to an illustrated description of ball bearings. 6 by 9 in.; pp. 34.

Blowers.

AMERICAN BLOWER CO., Detroit—Well-printed catalogue illustrating and describing blowers as installed in power houses, car barns, roundhouses, railroad shops, etc. 7 by 9 in.; pp. 50.

Coal Handling Machinery.

C. W. HUNT CO., West New Brighton, N. Y.—Pamphlet No. 081 illustrates and describes coal handling machinery, conveyors, industrial railways, etc. 3¼ by 6 in.; pp. 48.

Coal Handling Machinery.

JEFFREY MFG. CO., Columbus, O.—Bulletin No. 25 illustrates and describes a number of recent installations for handling coal and coke. 6 by 9 in.; pp. 12. Bulletin No. 16 is devoted to an illustrated description of electric rotary drills for drilling coal, slate, shale, rock salt, etc. 8 by 10 in.; pp. 10. Bulletin No. 15 treats of crab locomotives for gathering mine cars from the working face. 8 by 10 in.; pp. 16.

Concrete Piles.

HOLME CO., 34 W. 26th St., New York—Circular containing a brief illustrated description of corrugated concrete piles for foundations for buildings, bridges, chimneys, docks, bulkheads, etc. 6 by 9 in.; pp. 4.

Cranes.

NORTHERN ENGINEERING WORKS, Detroit—Booklet No. 24, pocket size, illustrating in condensed form, by means of about forty cuts, many of their designs of electric traveling cranes, hand power cranes, etc. Also electric hoists. 4½ by 3¼ in.; pp 32.

Cyanide Plants.

COLORADO IRON WORKS CO., Denver—Catalogue No. 10-B contains a brief illustrated description of the cyanide process and the machinery and equipment used. Fully indexed. 6 by 9 in.; pp. 112.

Drills.

CLEVELAND PNEUMATIC TOOL CO., Cleveland—Bulletin No. 40 illustrating and describing air hammer drills. 6 by 9 in.; pp. 12.

Dumping Grates.

WASHBURN & GRANGER, 120 Liberty St., New York—Booklet setting forth briefly, by illustration and description, the advantages claimed for the Dean dumping grate. 5¼ by 3½ in.; pp. 24.

Economizers.

B. F. STURTEVANT CO., Hyde Park, Mass.—"The Symbol of Durability" is the title of bulletin No. 102 illustrating and describing the metal-to-metal joints of the Sturtevant economizer. 3½ by 6 in.; pp. 8.

Electrical Equipment.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind.—Bulletins No. 1107 and 1108 illustrate and describe single-phase switchboard panels and multiphase revolving-field belted generators. 8 by 10½ in.; pp. 12.

Electrical Equipment.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletins Nos. 4596, 4597, 4600, 4601, 4602, 4603 and 4609 illustrate and describe respectively enclosing globes for arc lamps; astatic switchboard instruments; controllers for power and mining service; automatic voltage regulators for alternating and direct current generators; enclosed arc lamps for mills and factories; and lamp testing watt indicator. 8 by 10½ in.

Enameling Furnaces.

ROCKWELL FURNACE CO., 26 Cortlandt St., New York—Bulletin descriptive of an enameling furnace built without a muffle and using oil or gas as fuel. Illustrated. 9 by 12 in.; pp. 4.

Feed Water Purifiers.

F. E. KEYES & SON, 22 Broad St., New York—Circular illustrating and describing feed water purifiers. This device is installed between the heater and the boiler where it separates and removes the scale-forming material and sediment from the water. 3¼ by 8 in.; pp. 4.

Gas Engines.

OLNEY & WARRIN, 64 Centre St., New York—Booklet illustrating and describing gas and gasoline engines, together with tables of sizes of horizontal engines. 3½ by 6½ in.; pp. 6.

ROOT & VANDERVOORST ENGINEERING CO., East Moline, Ill.—Catalogue No. 7 is devoted to an illustrated description of gas, gasoline, naphtha, distillate and alcohol engines, together with tables giving dimensions, weights, etc. 7 by 10 in.; pp. 56.

AUGUST MIETZ, 128-138 Mott St., New York—Catalogue A 46 illustrates and describes stationary and marine gas and oil engines operated by kerosene, alcohol, fuel oil, distillate and crude oil from 1 to 120 horsepower, together with tables giving dimensions. 9 by 6 in.; pp. 42.

DU BOIS IRON WORKS, Du Bois, Pa.—Catalogue containing an illustrated description of horizontal gas engines designed to operate on natural gas, illuminating gas and gasoline. This catalogue treats of sizes up to 50 horsepower. Larger sizes are described in another catalogue. 6 by 9 in.; pp 24. Bulletin G-No. 8 is devoted to gasoline engines of the stationary and portable types. Illustrated. 6 by 9 in.; pp. 8.

Gauges.

AMERICAN STEAM GAUGE & VALVE MFG. CO., 208-220 Camden St., Boston—Catalogue, including prices, illustrating and describing gauges, indicators and other appliances for governing,

indicating, measuring, recording, and controlling steam, water, air, gas, oil, ammonia, and all other pressures. 6 by 9 in.; pp. 128.

Graphite.

JOSEPH DIXON CRUCIBLE CO., Jersey City—Booklet, printed in two colors, treating of Ticonderoga flake graphite. Each page deals with some particular phase of the graphite subject, and at the bottom of the page is given a testimonial bearing whenever possible on the particular phase treated on that page. Much interesting and valuable information is given. 3½ by 6¼ in.; pp. 12.

Industrial Railways.

ERNST WIENER CO., 66 Broad St., New York—Folder illustrating and briefly describing flat platform cars, portable tracks, dump cars, etc. 4 by 9 in.; pp. 4.

Meters.

CENTRAL STATION STEAM CO., Detroit—Catalogue No. 2 treats of the theory and practice of condensation meters and meters for measuring boiler feed water. Illustrated. 6 by 9 in.; pp. 12. Catalogue No. 3 is devoted to an illustrated description of general equipment for district steam heating. 6 by 9 in.; pp. 28.

Pipe.

AMERICAN SPIRAL PIPE WORKS, West 14th St. and 48th Ave., Chicago—Catalogue describing the many different uses for which spiral riveted pipe is especially adapted. Also contains testimonial letters. Illustrated. 7¾ by 10 in.; pp. 16.

Power Presses.

ZEH & HAHNEMANN CO., Newark, N. J.—Catalogue illustrating and describing punching, arch, wedge adjustment, straight side, double crank, armature disk notching, double action, screw and drop presses. 4 by 9 in.; pp. 12.

Reinforced Concrete.

EXPANDED METAL AND CORRUGATED BAR CO., Frisco Bldg., St. Louis—The July number of "Designing Methods" is devoted to an illustrated description of bridges and culverts for highway traffic. 5½ by 8½ in.; pp. 106.

CLASSIFIED ADVERTISING SECTION

Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.

Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.

SITUATION WANTED

GRADUATE ELECTRICAL ENGINEER, with 8 years' factory experience, wishes position, assistant superintendent or foreman. Can manage any nationality. Address BOX 128, care of THE ENGINEERING MAGAZINE, 140 Nassau St., New York. 1-9

FOR SALE

FOR SALE—24' x 42"—15" bore Belt Fly Wheel, eight arm, sectional, Allis-Chalmers make. Perfect condition. LOUISVILLE COTTON MILLS CO., Louisville, Ky. 6-2

BOOKS

FOR SALE—30 volumes Engineering Magazine. Vols. 2 to 22 inclusive, bound, 23 to 31 unbound. Address H. C. MILLER, 1 Madison Avenue, New York. 1-9

THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guesswork; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

EVERY PRACTICAL ENGINEER should compile his own note book. Subscribe for Webber's tables, printed on 4x7" sheets, for insert binders. Every engineering subject, 25 cts. per sheet, printed on both sides. Write for information to WILLIAM O. WEBBER, Consulting Engineer, 432 Exchange Building, Boston, Mass. 12-8

THE ENGINEERING INDEX ANNUAL for 1907 embraces all branches of engineering, and clearly indexes alphabetically by subject about 9,000 important articles of permanent value which appeared during 1907 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed, in the original language, together with all accompanying illustrations. 450 pages, 9¼ by 7 inches, cloth binding, $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

PROFIT-MAKING IN SHOP AND FACTORY MANAGEMENT, by Charles U. Carpenter, President Herring-Hall-Marvin Safe Co. Profit-making management is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as a supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive. 146 pages, 6 by 8½ inches, cloth binding, $2.00 prepaid. THE ENGINEERING MAGAZINE, 140-142 Nassau St., New York.

MIAMI UNIVERSITY

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SEPTEMBER, 1908.
PRICE, 25 CTS.

THE ENGINEERING MAGAZINE

REGISTERED, U. S. PATENT OFFICE

SPECIALLY DEVOTED TO THE INTERESTS OF

ENGINEERS, SUPERINTENDENTS & MANAGERS

EDITED BY JOHN R. DUNLAP
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